35 mm.
FILMSTRIP
Technique

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AUTHOR'S FOREWORD

This booklet has been prepared expressly for all those interested in Filmstrip from both its technical and educational aspects.

The information contained herein has been gleaned from many sources, for the various methods described are suited to different needs. The serious worker will soon develop his own particular technique, which may incorporate one or more of the suggestions put forward here.

As an attempt has been made to present a cross-section of the methods and techniques in common use to-day, the author would particularly like to acknowledge the great assistance he has received, not only from the technical department of Ilford Limited, but also from Miss F. E. McAdoo, F.R.P.S., and Miss K. Ritchie, for their untiring help in the preparation of the manuscript and illustrations.

London,
December, 1948

PETER HANSELL

PART ONE

PRINCIPLES and APPLICATIONS

Introduction:—range of individuals and authorities to whom filmstrip appeals: definition and meaning of terms used in this work: frame sizes in common use: types of strip: (a) the simple strip and by analogy the colour strip: (b) the planned sequence strip in which only one type of original material is involved: (c) the mixed strip involving all forms of original material: (d) the self-explanatory strip including full captions: scripting: filing: storage.

INTRODUCTION

35 mm. technique enjoys considerable popularity both in the amateur and professional fields; it has been applied successfully to the whole range of photographic activities, from the pictorial to the scientific end of the scale.

Educational aspects have also to be considered, and schools have not been backward in this respect, for while the old "magic lantern" needs no introduction, the advent of the filmstrip and the miniature slide has placed all the advantages of the older methods within the grasp of less affluent individuals and communities. To name but a few possibilities, many people will recall the considerable use which was made of filmstrip in the training of men and women in the Services. While this continues, one now finds the idea pervading technical colleges and workshops. Certain potentialities still remain relatively unexplored, though it is not difficult to realise, for example, how a portable demonstration in the form of a filmstrip might do much to ease the burden of a travelling salesman.

Moreover, in all fields, but particularly in education, miniature technique offers certain additional advantages over older, cumbersome methods, but in a monograph of this size it is impossible to deal with these in detail. The main object of this little book is to present as many facets of the production side as possible, so that, armed with these practical considerations, the reader will be better able to work out his own applications.

Though we are primarily concerned with filmstrip, the miniature or 2 in. square lantern slide should be thought of in parallel, for the two are closely related. Some additional information has, therefore, been collected and forms the substance of Part Six.

DEFINITION OF TERMS

Before proceeding to examine the various types of filmstrip which could be produced for various needs, it would be as well to define the term more exactly, for to many people the word merely implies a string of lantern slides, and to others it conjures up complexities which do not exist. Although it is difficult to be concise in this matter, a *filmstrip* may be said to consist of an orderly sequence of

subjects and information recorded on 35 mm. film. The unit of the strip is the *frame* and each frame is designed to be projected separately; that is to say, as a still picture. The presentation of a definite story, or the promotion of a train of thought, by virtue of the frame sequence, is also implied when the term is used in its strictest sense.

Several refinements could be added to this definition, for instance, the British Standard Specification No. 777:1938 states that the film employed should be of the "safety" or non-inflammable type, and though recommending 35 mm. film it allows of two types of perforation and frame size. To those who wish to pursue the matter further, the Ministry of Education Memorandum No. 17/16A (1946) contains much valuable information, and further defines Filmstrips, Filmslides and Shortslides.

In the pages which follow it is not proposed to pay strict attention to such minutiæ, but where reference to the final diapositive is made, "safety" material (B.S.S. 850:1939), and standard positive 35 mm. film (B.S.S. 677:1942) are normally implied.

FRAME SIZES

During the natural development of filmstrip, a great number of different frame sizes have been advocated at various times. Now that some uniformity has been reached in the manufacture of miniature projectors the choice of frame size has been narrowed down considerably, and it is, therefore, proposed only to deal with the two in common use. There is a great deal to be said for the preservation of this dual standard, but a few other suggested sizes and arrangements for special purposes are listed in Appendix "A".

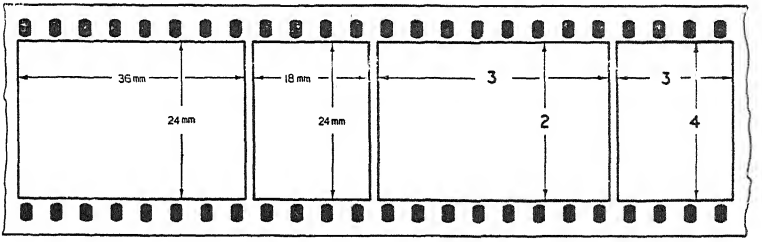


Fig. 1. The two recognised frame sizes and ratios

The standard motion picture camera, and the generally accepted miniature camera may be said to have regulated the picture sizes of the present day. Hence in filmstrip technique there are to be found the "single-frame" (18 mm. × 24 mm.) related to the standard motion

picture, and the "double-frame" (24 mm. × 36 mm.), which is a size familiar to miniaturists. The single frame is favoured by many commercial firms, for, in addition to economy of material (there are sixteen frames per foot of film), the format is said to be more convenient, having sides in the ratio of three to four. The double frame size, however, will no doubt appeal more to the amateur and to those who are of the opinion that quality must suffer when the smaller size is employed: a larger projected image will also result.

Most modern projectors are fitted with masks, making them capable of accommodating strips of either frame size. It will be realised that the projector apertures are slightly smaller than the sizes just mentioned, and on occasion it may be necessary to make allowances for this. (B.S.S. 677:1942).

TYPES OF STRIP

1. In its simplest form the filmstrip need not be anything more than a train of lantern slides on film, differing mainly in the fact that the emulsion surface is obviously unprotected. There is fairly general agreement that transparencies, when projected, impart a greater range and brilliance to any picture, and for this reason the owner of a miniature camera may wish to preserve his more creditable photographs in this form.

The colour films of to-day are mainly commercially processed, and, on account of inconsistencies in exposure which easily creep in, the usual practice is to mount the better frames as miniature slides. There arises the occasion, however, when a whole roll of film has been devoted to one particular subject: if exposure has been reasonably accurate, it may then be preferable to retain the record as a simple filmstrip in the form just described.

If we take this one stage further, it will be seen to be a simple matter to add the refinement of a caption frame at the beginning of the strip, and in this way it would be possible for the amateur to build up a small library of simple strips, recording his holidays, his travels, and so on. Further elaborations will occur to the reader, and later it will be described how titles may be added to such frames.

2. Passing from the simple strip to one approaching our true definition, we must consider the planned sequence strip, in which only one type of original material is involved. In general it may be said that this type of strip should attempt to relate a story, and the order of the frames should be planned beforehand; the subject matter, however, will all be of one type, and may for example consist of straightforward snapshots, drawings or diagrams, radiographs or

cartoons. The general similarity of one frame to the next promotes continuity in itself, and from the technical standpoint certainly permits of greater standardisation of work.

3. As a variant of the above, the mixed strip must also be given a place. In this instance continuity is still the guiding principle, and all types of original material may be marshalled to fulfil this aim—for example, a complicated photograph may be preceded or followed by an explanatory diagram which in subsequent frames might give place to close-ups and other data.

In the production of the final print it will be obvious that with such a diversity of subject-matter full use must be made of the latitude of the film stock, and it is therefore important that the characteristics of this should be well known. From the production point of view this type of strip is probably the most difficult to make with any degree of technical perfection.

4. It is often assumed that most filmstrips are prepared with the idea that they will be accompanied by some form of verbal exposition. Occasions do arise, however, when it may be desirable for a strip to be entirely self-explanatory: this is particularly true if strips are to be used for individual study, or by persons other than the author. This can be achieved largely by the inclusion of adequate captions within the frame area, and also by the interpolation of special caption frames. As a guiding rule it should be stated that words used should be as short and as few as possible to convey the necessary message; a maximum of five lines of writing in any one frame is suggested. The part played by explanatory notes which may be issued with a filmstrip is discussed in the section immediately following.

SCRIPTING

From the production standpoint it is interesting to compare the filmstrip with the motion-picture film, for the two have a great deal in common. When the preparation of a filmstrip is contemplated, it is often helpful to visualise it as a film but without inherent movement; the close similarity between the two will be better understood if it is realised that a filmstrip enables a teacher to present sequences of a subject or story at any rate he desires, and he may do much to regulate the tempo in order that emphasis may be thrown on any particular point while still relating it to a whole.

With this comparison in mind it will be seen that accurate scripting must play as important a part in filmstrip as in film production. Experience shows that a great deal of time and materials are saved

even if as much as half the total time is spent on planning and preparation of a lucid script. It is of prime importance that the objects and purpose of the strip should be quite clear at the outset, and while it is usual to have some definite audience level in view, it is as well to assume a fairly low level of previous knowledge of the subject. It is difficult to over-simplify a filmstrip, but on the other hand it is easy to complicate it.

The first step in the preparation of a script should be to list the frames as visualised in their proper order, together with possible sources of material, and decisions regarding the type of treatment which each frame is to receive. A specimen rough layout is shown below:

Frame No	Subject Matter.	Type of treatment	References.
1.	Title Frame.	Art lettering "Housing" on background of small estate.	Background Neg. No 6789.
2.	Historical landmarks.	Bold list of 5 main dates	See XYZ: 1940 p 46.
3.	Contrast between Hovels & the new.	Split-frame showing condemned houses on L. & modern houses on R.	Negs No 54 & 87 ? Montage or double print the frame.
		(additional space for sketches is an advantage.)	

Fig. 2. Portion of a typical rough script

When this stage has been reached it is convenient, and in the end time-saving, to divide the work into convenient technical sections: thus the equivalent of a rough "shooting script" is drafted. This, for example, may divide up the work into line, half-tone, montage and special effects. In this way one part of the script may be in production while drawings, etc., for another part are in the process of preparation.*

The above comments on scripting do not, of course, apply to the simpler forms of strip previously listed, but they will certainly concern the enthusiast who is anxious to make the most out of this medium.

FILING

The use which may be made of the scripts as described does not end with the completion of the filmstrip. The original script will be found

* *This scheme is not applicable to "single-copy" methods, which are described in the following pages.*

most valuable when it is intended to write notes to accompany the strip. In many cases it will in fact form the basis of these notes, and in a later section (*see The Value of the Paper Print, page 26*) it will be seen how a rough paper print may be divided up and mounted in sequence alongside the corresponding notes.

The shooting script, on the other hand, should be liberally annotated with details of exposure and printing times. If this is done it will be found invaluable at a later date when for one reason or another it is necessary or desirable to revise an existing filmstrip.

STORAGE

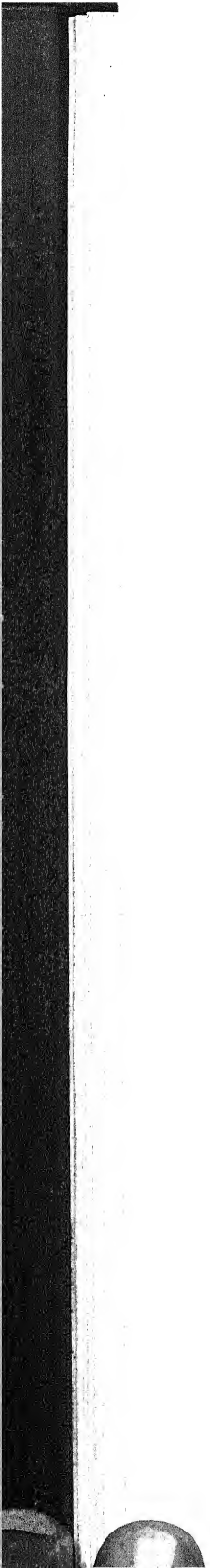
When there is ample space available, filmstrips can best be stored singly in small cans; these may be made of tin or pressed aluminium, but it is important to ensure that they are smooth, and constructed of a material which will not injure the film.

The British Standard Specification No. 1153:1944 makes certain recommendations regarding dimensions, and suggests that storage containers should consist of a pressed body with a rebate to facilitate removal of the film, and a round, seamless slip lid. The dimensions mentioned, however, are somewhat cumbersome, and a 2-in. diameter can of height 1½ in. has been found very suitable. Where possible, these containers should be stored in such a position that the film inside rests on one of its edges; hence it is advisable to place any index markings round the periphery of the container. Needless to say, this index marking should be repeated on the leader strip.

PART TWO

EQUIPMENT

List of equipment needed for all the methods later described: Notes on the above equipment.



EQUIPMENT

Equipment necessary:

(a) Contact printing box to carry roll of sensitised material. (Up to 10 ft. in length.)
(b) Various types of sensitised material—*see Part Four.*
(c) Spiral developing tank and/or dish with porcelain weight.
(d) Enlarger; should also be capable of three times reduction.
(e) Standard light source (*e.g.*, conventional printing box), for contact printing.
(f) Photometer, exposure meter, or densitometer.
(g) Precision miniature camera, 35 mm.

For the methods described in the pages following, all the above equipment is desirable: certain methods, however, require less total equipment than others; item *(a)* or *(g)* will be necessary for the production of the final diapositive but both are not essential.

NOTES ON THE ABOVE EQUIPMENT

(a) Printing box. Some type of contact printing box is, to say the least, desirable. The Ilford 35 mm. Filmstrip Printer has been expressly designed for printing 35 mm. negatives direct on to positive stock and a short description of this apparatus is appended.

Ilford Filmstrip Printer (Fig. 3). A spool and sprocket mechanism inside the body of the printer passes positive film from right to left when a milled wheel in front of the instrument is turned. The hinged lid embodies a combined pressure platen and masking frame fitted with channels to engage the negative record. The film wind cannot be operated when the pressure platen is locked for exposure, thus preventing damage to the negative.

Positive material is metered out accurately for correct spacing between frames and an exposure counter is provided.

Two interchangeable masking platens are provided for full frame (24×36 mm.) and half frame (18×24 mm.) pictures respectively.

Take-up and feed spools will accommodate up to 10 ft. of positive film and both spools are interchangeable.

The printer may also be used in conjunction with an enlarger for printing larger negatives by reduction.

Other printing boxes have been available in the past, but in general are not readily obtainable at the present time. The best known of these is the Leitz "Eldia" printer. An illustration of this appears in Fig. 4 and a full description and working instructions are to be found in the Leica Manual.

For the more resourceful reader, a description of the home-made printing frame appears in the Ministry of Education Supplementary Memorandum No. 2, entitled *Apparatus for Printing Filmstrips*. This consists of the simplest modification of the well-known printing frame, but does not allow of easy manipulation where regular production of filmstrips is envisaged.

(*b*) *Sensitised material.* One great factor in favour of 35 mm. material is that a number of emulsion types are available: the type of film, therefore, can be readily chosen for the particular work in hand. Complete specifications, together with technical data, appear in Part Four.

(c) Processing equipment. Apparatus required for processing miniature film is to be found in most darkrooms. Commercial firms usually favour mechanical equipment where long lengths of film are involved, but the amateur, and the worker who wishes to process his own material, will probably depend upon the customary 35 mm. spiral developing tank, which is capable of handling between five and six feet of film. It is useful to remember that the miniature frame is approximately 1½ in. long, and therefore there are eight frames per foot of film (when the cine frame size is employed there are sixteen frames per foot of film). For the sake of economy sensitised material for filmstrip work is usually purchased in bulk, that is to say, in rolls of not less than 100 ft.

When only short lengths of film are involved, it may prove uneconomical to use a developing tank; in such cases there are many alternative methods, one of the simplest being the use of a porcelain developing dish weight. This ensures immersion of a loop of film which is constantly agitated by hand ("see-saw" method).

(d) Enlarger. An enlarger is mentioned in the above list, for occasions do arise when it is desired only to include a portion of a negative in the final frame. Small degrees of enlargement are perfectly permissible, and do not detract from the quality of the final result.

Certain models of enlarger, however, are also capable of producing a reduced image, either by virtue of bellows extension or by the use of extension tubes: this type of enlarger will be found invaluable in filmstrip work, and on pages 20 and 24 a method is described in which negatives up to about quarter-plate size may be employed in

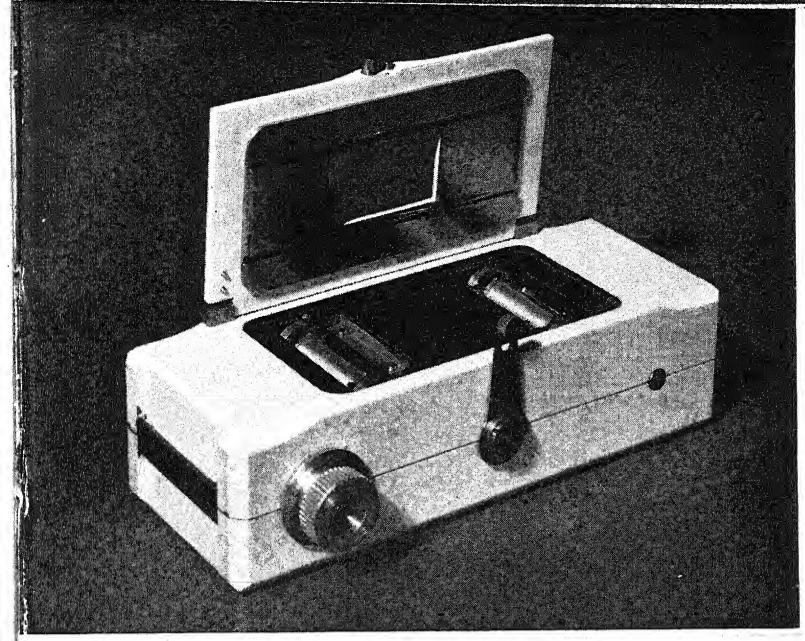


Fig. 3
Ilford Filmstrip Printer

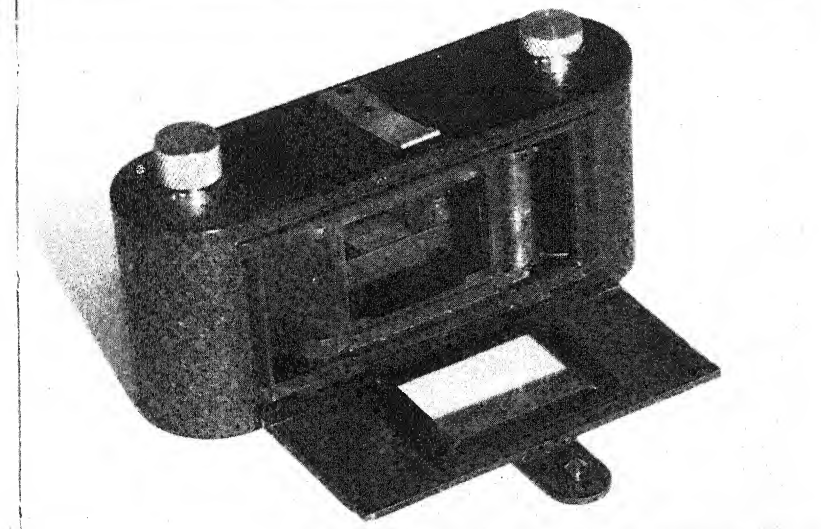


Fig. 4
Leitz "Eldia" Printer

Fig. 5
Ilford 35 mm. Film Developing Tank

the production of a filmstrip. In this case, however, an enlarger capable of three times reduction is necessary.

(e) Standard light source. The choice of a standard light source is, of course, an individual one, but the adoption of a standard source of illumination cannot be stressed too greatly, for only in this way can experience be called upon to determine the final modifications of exposure time. In the average darkroom, however, a normal printing box will be found admirable for this purpose. For more delicate control over printing and exposure many deem it desirable to maintain constant voltage through the source of illumination. Some data on the effect of voltage variation on exposure time are to be found in the section on "Reversal Processing".

(f) Meter. When negatives of comparable average density and contrast can be produced with confidence, there will obviously be little use for some metering device. This, however, is rarely the case, and it is often necessary to be able to produce a filmstrip from a set of negatives of varying quality: here a densitometer, a photometer, or a suitable exposure meter will prove extremely useful in assessing the printing time relationship between these various negatives. Several methods of calibration are available for these instruments, but it is not proposed to discuss them here.

(g) 35 mm. Camera. As will be seen in the following pages, it is not essential to possess a 35 mm. camera in order to be able to produce filmstrips. It is, however, a great advantage, and in fact a miniature camera with a detachable lens makes it possible to dispense even with a contact printing box. Furthermore, it is often convenient to use a miniature camera for a definite section of the work involved in the production of a complete strip: document copy work, for example, is handled extremely well by the modern miniature camera.

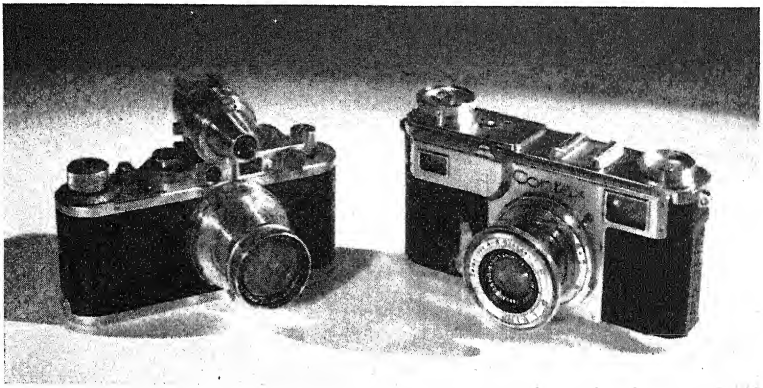


Fig. 6. Leitz "Leica" and Zeiss "Contax" precision miniature cameras

PART THREE

METHODS

The "Key Print" method; an adaptation of the commercial method: reduction method; reduction of large negatives to 35 mm. strip: the use of metering devices: single copy methods: (a) simple contact printing from assorted negatives: (b) copying of large negatives transilluminated: (c) reversal processing: preparation of filmstrips without a 35 mm. printing box: (a) using a camera body with lens removed: (b) 1:1 copying direct employing 35 mm. camera: (c) the home-made printing frame: the value of the paper print (on 35 mm. perforated bromide): inserting captions and making caption frames: lettering: methods of printing; some practical values and times: test focus frame: determining exposure time.

METHOD ONE

KEY PRINT METHOD

This method is most commonly used by commercial firms, where a strict division of labour is easy, and standardisation at all stages is essential. As described, the method is extravagant of material, but should appeal to the serious worker, for in the end a consistent and polished result is invariably attained.

As already mentioned, a script is prepared, and from this rough sketches conveying a general impression may be made. This will help to decide what part of the work should be in terms of drawing or diagram, and what part in original photographs. The former part is laid aside and there follows a production of layout drawings: in a commercial studio these key drawings are passed on to specialised artists who prepare finished "master-cards" of standard dimensions. The purely photographic side of the work may be resolved into material which already exists, and material which must be specially taken; in the latter event it is as well to make several shots when the slightest occasion for doubt arises, for it is unlikely that the finished result will closely resemble the original script and it is wise to make allowances for the process of fermentation which proceeds apace with the production. After such scenes have been photographed, proofs are examined, and may be marked for trimming, and, subsequently, new prints are made with the cropped area enlarged to fill the field of the camera in use.

The final size of prints and diagrams must be determined by working conditions, but a convenient size of whole-plate, or 8 in. × 10 in., is frequently quoted.

Needless to say, art-work and title layouts are brought up to the same size as the photographed bromide prints. Referring again to the example set by commercial firms, these master cards are punched with some sort of registration holes, customarily one square and one round. (These appear at the top of Fig. 7.)

Thus by means of identical pins, which are fitted on artists' drawing boards and camera base-boards, drawings, and any over-lying sheets of celluloid bearing titles, are accurately located in relation to the camera lens: a skilled camera operator is therefore not essential.

As described above this method is generally not applicable to the amateur worker, but he may find it an advantage to prepare bromide prints of standard size, and similarly dimensioned drawings of his intended material (Fig. 7). This method facilitates numbering of individual frames, and any captions which are to be added may be drawn out on a piece of celluloid (*see section on adding captions*), which is then laid over the bromide print or drawing prior to photography.

Unless these prints are extremely carefully prepared, often necessitating tedious retouching, their tonal values may change considerably during this second photographic process—not uncommonly they gain in contrast. A simple method of averting this is to make master prints through a fine line or dot screen, placed in contact with the paper.* This appears to flatten the prints considerably, but on re-photographing it will be found that the final tone values approximate very closely to the original. The dot pattern on the screen will not be apparent at a distance greater than three to four feet from the screen on which the final image is projected.

The method outlined above may well be considered wasteful and tedious from the amateur worker's point of view, but it should be pointed out that the final master negative strip may be sent straight away to a commercial establishment for processing and printing, and the author can be certain that the final result will be of a uniform quality. Even if commercial processing is not desired, a master negative of this type may be printed very simply using the contact printer as described later in the booklet.

Depending on the length of the strip and the whim of the worker, two general types of camera may be used for this type of production: the old, hand-cranked standard 35 mm. motion picture camera, capable of exposing one frame at a time, is eminently suitable for a single or cine-frame strip, and the modern miniature camera of the Leica or Contax type may be called upon to provide a double-frame image size. Extremely efficient copying devices are often obtainable as accessories for the latter type of camera, and these will do much to reduce physical effort and ingenuity to a minimum (Fig. 8).

Commercial copying cameras such as the Sayce-Watson and other microfilming cameras may be used perfectly satisfactorily for the production of master negatives. Care should be taken, however, to make sure that the frame size and dimensions agree with filmstrip standards.

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* *Such as the Gestetner half-tone contact screen for Airgraphs.*

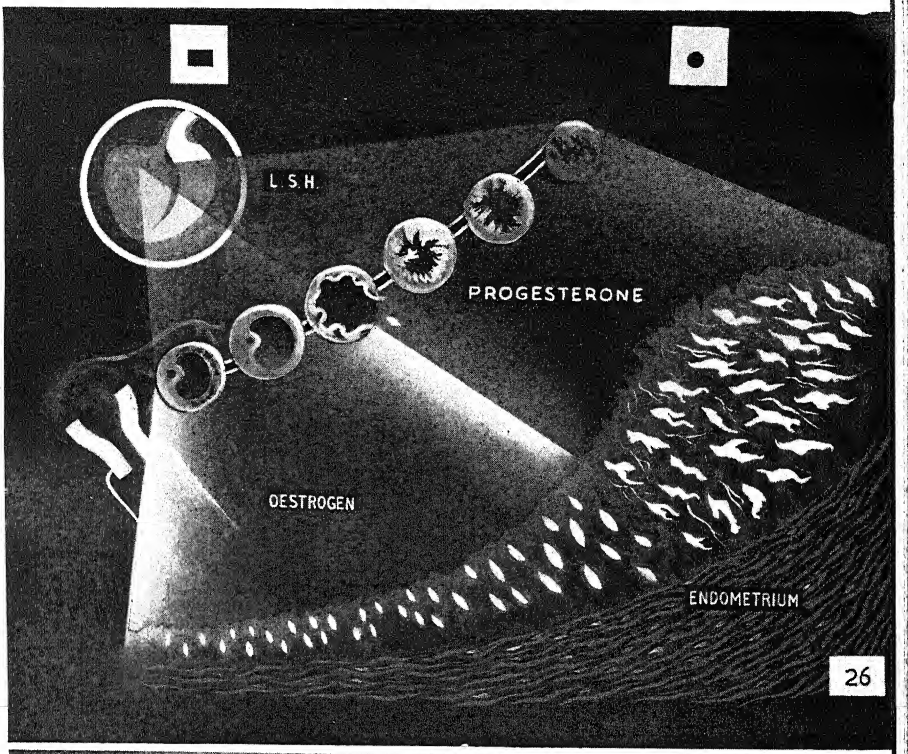

Fig. 7
A typical "master card". Note registration holes and frame number

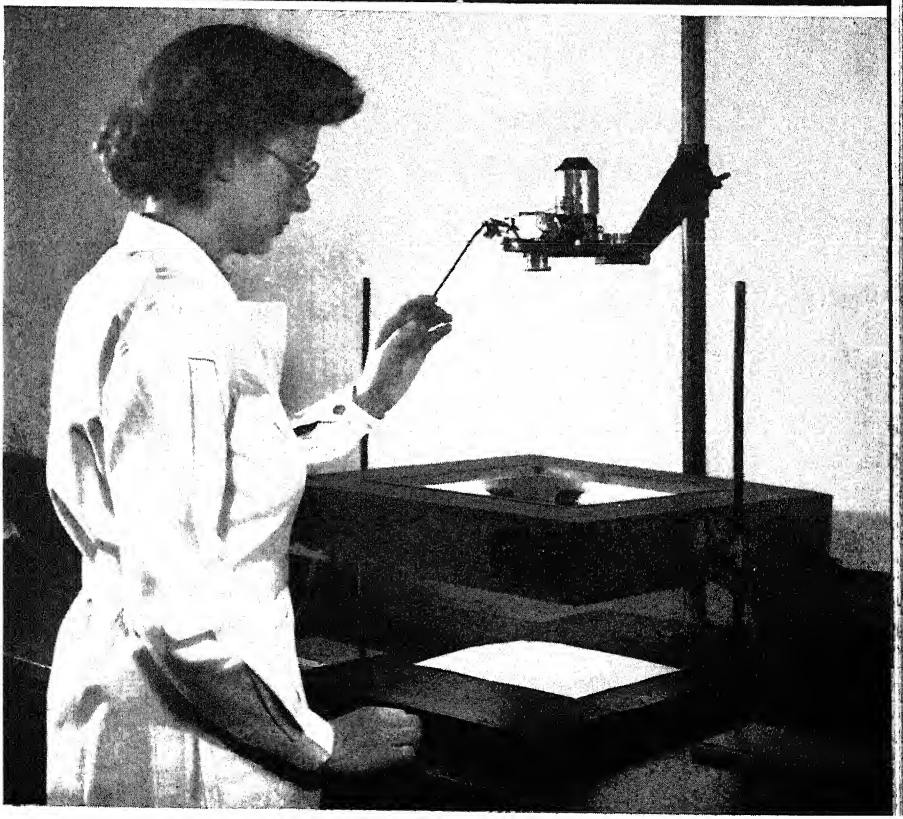

Fig. 8
Copying master cards or prints. The copy is illuminated by strip-lighting and the camera is mounted on the Leitz rotating copy device

METHOD TWO

REDUCTION METHOD

It is by no means essential to possess a 35 mm. camera to produce filmstrips of high quality. Many workers will employ negatives of sizes 4 in. × 5 in., quarter-plate, or even less. Provided some form of printing box is available, as mentioned in the section on equipment, there is no reason why such negatives should not be employed in the production of a filmstrip. The only additional piece of apparatus which is necessary, though this is not always to hand, is an enlarger which is also capable of producing a reduced image to about a third of the original dimensions. This may be made possible by virtue of extreme bellows extension, or alternatively, it is a simple matter to affix the required extension tubes between lens and lens panel of the enlarger body.

The 35 mm. printing box is then merely loaded with positive stock, and is placed upon the enlarger easel; the enlarger is set to reduce the image of the larger negative to a proportion which approximates to that of the single- or double-frame mask of the printing box, and successive negatives are fed in, according to a pre-determined order. Frame numbering may be achieved either by placing opaque numbers in a suitable position in the enlarger negative carrier, or by placing tiny numerals upon the glass pressure-plate of the printing box.

In the previous method it was suggested that proof prints might require cropping before being finally used, but in the method which is now described, it is easy to see that this eventuality may be largely overcome. By simple re-setting of the enlarger it is possible to include as much or as little of a given negative as desired.

METERING

When such a method is used, almost any sensitive photo-electric exposure meter may be used to determine the average negative density (which in this case is likely to vary considerably), and after some common factor has been computed, successive exposures may be made without first making test prints. *(See also "Value of the Paper Print".)* A densitometer may be used for the same purpose, and the

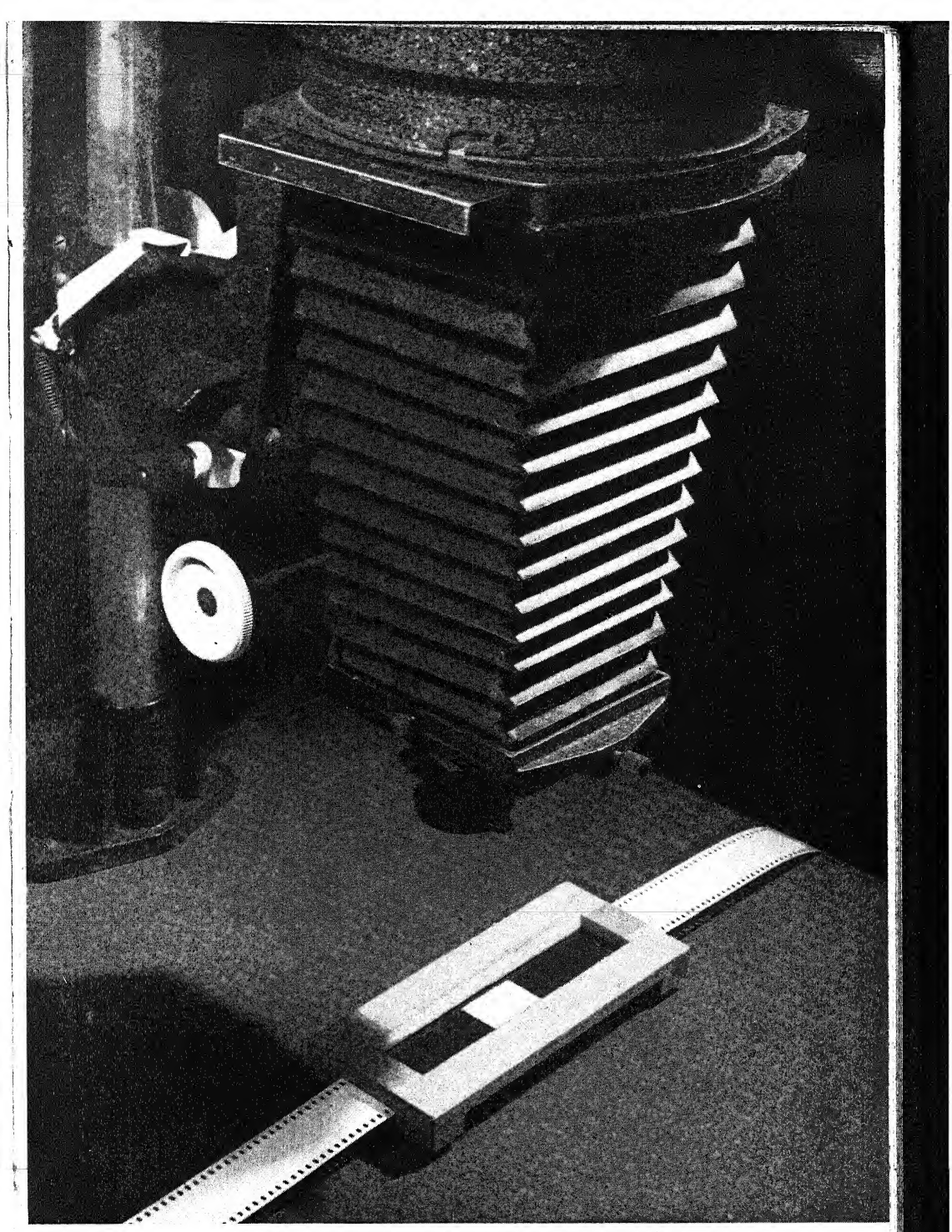

Fig 9. Enlarger set for reduction, thus enabling larger negatives to be printed direct on to 35 mm. film. Darkroom illumination must be by suitable safelight

ingenious worker will even find that considerable use may be made of the simple grease-spot photometer in this connection. The S.E.I. Exposure Photometer, which has recently appeared on the market, does in fact employ the photometric principle, and as illumination or transmission densities may be read from an extremely small area, this meter should be eminently suitable for the purpose discussed above.

Method One is, of course, the method of choice when it can be anticipated that more than one copy of a strip will be required. The master negative will be carefully preserved and is of constant quality.

If Method Two involves a great deal of labour, which is often the case, it may be advisable to make a duplicate negative in the form of a strip from the final print, before this is defiled and damaged by projection. This may be done commercially on duplicating stock.

Bearing in mind the inherent limitations of filmstrip, however, unless an enormous distribution of copies is visualised, it may be more labour-saving to produce only one copy. If projection of this copy is fairly infrequent a long life may be expected (50–100 screenings), at the end of which time revision will almost inevitably be desired.

The remaining methods, therefore, aim at the rapid production of single copies, and unless duplication, as mentioned above, is undertaken, the whole sequence of operations must be repeated for every copy—this, however, is not as arduous as it might seem at first sight. Roughly speaking, a projection copy can be produced by the methods described below in little over half an hour.

SINGLE-COPY METHODS

1. The amateur photographer who possesses a miniature camera will not, in all probability, be interested in the production of multiple copies, and his need will be more in the nature of preparing composite strips from his existing miniature negatives. Such negatives are commonly filed in albums in strips of half a dozen; it is, therefore, impracticable to make a master negative strip.

By means of a contact printing box, as already described, it is possible to make the requisite selection of strips of negatives and to print these in any sequence desired. The result, however, is only one continuous positive strip for projection.

The printing box is also capable of taking single 35 mm. negatives

in the negative carrier, and when thinking in terms of single negatives it is worthy of note that the simple printing frame described in Ministry of Education Supplementary Memorandum No. 2 enables portions of larger negatives to be printed on a continuous length of 35 mm. positive film.

2. A modified technique can be employed for the production of single copies from large negatives. In Method Two described above, the availability of an enlarger capable also of reduction was assumed, but this is not a necessity.

An alternative method is to place the larger negatives on a light box, consisting of a flashed opal top, illuminated from below. A reduced copy of these negatives in sequence is then made by means of a miniature camera and some suitable copying device.

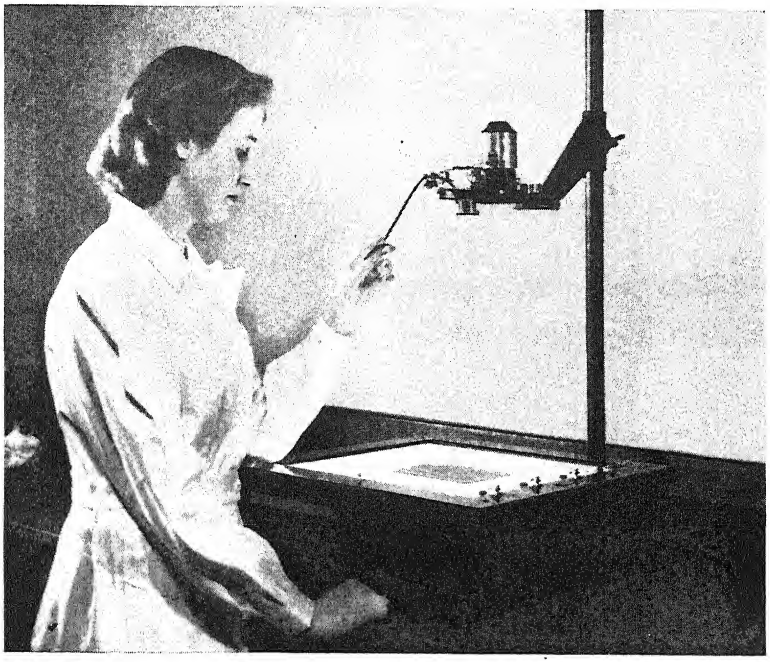

Fig. 10. Copying larger negatives by retro-illumination. Normally all the unwanted area is masked off

There are several varieties of copying equipment available, the better known of which are the Leitz rotating and sliding copiers, and the Leitz Belun attachments.

This will, of course, give a direct positive print on development,

and should duplicate copies be required these may be made by producing a duplicate master negative, or by simple contact printing with subsequent reversal. *(See Section on Reversal Processing.)*

If the necessity of a master negative can be well foreseen, and the accurate matching of the tonal values of bromide key prints (Method One) is too arduous, it is quite feasible to make positive transparencies of large negatives by contact printing on suitable duplicating film. These transparencies are then subjected to the sequence of operations described above; the result will then be a negative strip.

This latter method has been mentioned in passing not for reasons of economy, but because having embarked on a filmstrip production programme, certain individuals may be desirous of converting existing 3¼-in. lantern slides into filmstrip—this method then becomes the one of choice.

3. By deduction it will be realised that a single copy of a filmstrip may be produced quickly and economically by the simple reversal processing described later in this booklet. Thus, a strip produced by Method One, or by shooting of material in the camera in the correct sequence, can be dealt with in this manner, and perhaps its best application is in the conversion of existing lantern slides into strip form when the original negatives are not available.

When this technique is contemplated, it should be borne in mind that the camera must be loaded with some suitable stock, such as Ilford Fine Grain Safety Positive film: many other emulsions are not suitable for reversal processing.

PREPARATION OF FILMSTRIPS WITHOUT 35mm. PRINTING BOX

1. A 35 mm. contact printing box is not necessary for the production of filmstrips in the manner described on pages 17 and 18 (Method One). In this event, however, it is essential to have a miniature camera with detachable lens; in this case the camera is previously loaded with positive stock, the lens is removed, and the camera body placed on the enlarger base-board in place of a printing box. The shutter, which is customarily of the focal plane variety, is set to "Time" exposure, and may be used to regulate the printing time. Successive frames are then exposed in the usual manner, winding the camera mechanism between each one.

The thickness of the camera back must be taken into account when focusing the image, and as this thickness varies from camera to camera it is advisable to construct a small block of wood or card with a white upper surface, such that its thickness is exactly equal to the distance between enlarger base-board and film plane. This will do much to obviate many of the difficulties which have been attributed to this method of working.

2. By means of the elegant accessories which are now available to the owners of the more versatile miniature cameras, it is possible to produce filmstrips not only without a printing box, but without an enlarger as described in the preceding section. By means of additional apparatus, such as the Leitz Belun attachment, or the Roth Auxiliary Stand, direct 1:1 (actual size) reproductions can be made.

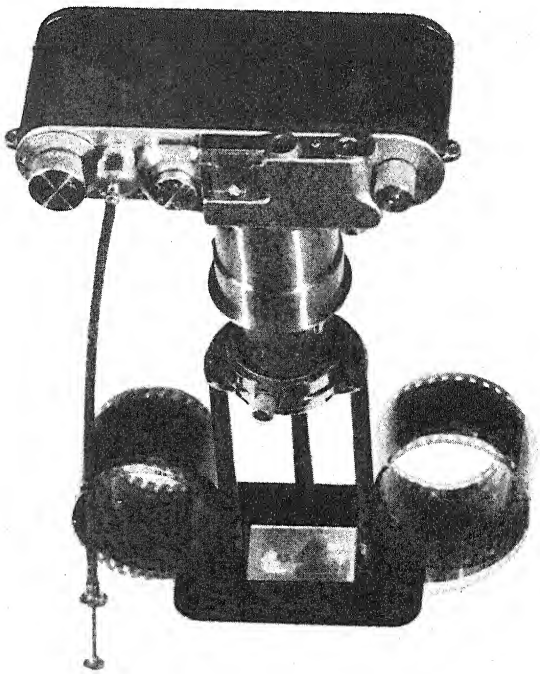

Fig. 11
The Roth Auxiliary Stand for direct 1 : 1 copying

If such equipment is available, therefore, appropriate 35 mm. negatives may be selected in sequence, and with the aid of a light box may be copied to give a direct positive in the camera. Again it will be advisable to suffer the inconvenience of relatively lengthy exposures and load the camera with 35 mm. Fine Grain Positive Stock.

Miniature colour transparencies are invariably single and valuable, but this equipment offers a way in which such transparencies can be converted into monochrome negatives and hence incorporated in continuous strips.

3. The simple home-constructed printing frame has been mentioned previously, but for the sake of completeness must be referred to in this section. Full working instructions are to be found in the reference already given.

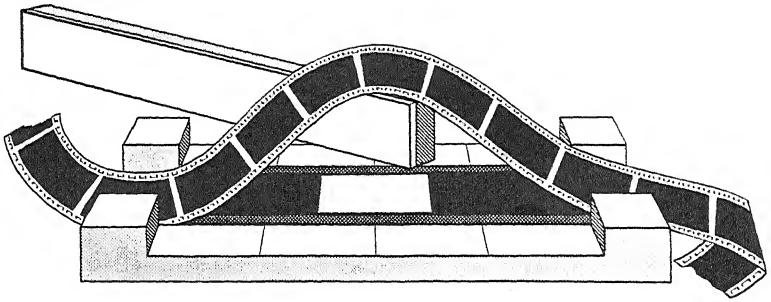

Fig. 12. A simply constructed 35 mm. printing frame

THE VALUE OF THE PAPER PRINT

It will be quite clear that uniform quality is an essential feature of any finished strip. This is easy to attain under controlled conditions as described in the "Key Print" method: here exposure and printing times can be standardised throughout.

In the other methods described, however, it is largely assumed that a number of assorted negatives will be available from which to construct the projection strip. In this case, therefore, it is unlikely that their quality will be uniform, and hence all final adjustments must come in the actual printing process: in practice the printing time of assorted negatives selected at random varies considerably.

It is in these latter methods, therefore, that a trial paper print on 35 mm. perforated bromide paper will be found singularly useful. For test purposes paper is very much more readily handled than film, and in the case of direct contact printing, with the negative in position in the printing box, a few inches of paper may be torn off a roll and slipped beneath the platen of the printing box: a test exposure is then made and developed at once. The same is, of course,

true when larger negatives are being reduced by projection through the aperture of the printing box.

It should be mentioned at this stage that for all practical purposes the speed of Ilford B.2.1P. perforated bromide paper has the same speed as Ilford Fine Grain Safety Positive film, and hence a direct comparison is possible. The only point which should be borne in mind, however, is that developing times of paper and film are likely to differ: for this reason it is good practice in filmstrip work to employ a universal type of M.Q. developer, so that it may be used for both paper and film with their respective recommended development times.

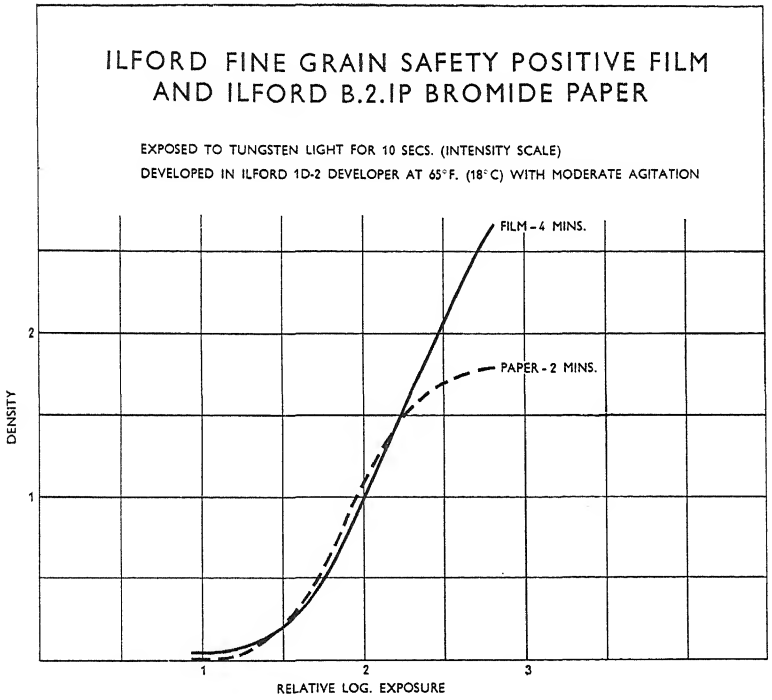

Fig. 13. Ilford Fine Grain Safety Positive film and B.2.1P. paper compared

It may be sufficient to take representative negatives from the batch and perform single test exposures on paper as described above. The exacting worker, however, may wish for further refinement; if this is the case representative test exposures should first be made, after which the 35 mm. contact printing box is loaded with a suitable

length of perforated bromide paper, and a paper print of the complete strip is run off using the printing times of the primary tests as a guide, and estimating visually the minor variations from negative to negative.

This paper copy is then developed and fixed in the usual manner; in view of the comparatively short development time, dish development with the aid of a porcelain weight will probably be found to be easier than the employment of a tank. After fixation and brief washing the paper strip may be removed, swabbed down, and examined critically in daylight or artificial light.

It is extremely rare for such test strips to be anything like perfect throughout, but if a modicum of care has been used they should not be very far out. Even so they are by no means wasted, for as a record of the exposure times will have been kept this may now be checked and finally adjusted prior to printing the projection copy on film. If it is intended to keep the paper copy it should now be further washed and dried—it may even be glazed in sections on a comparatively small electric glazer. Filed in a coil in the same tin as the filmstrip, it forms an instant key to the contents of the strip, suitable for viewing even in adverse conditions. Alternatively, the constituent frames may be divided and stuck in the margin of the script or against notes which may accompany the strip. While imperfect in exposure they may be, they will, nevertheless, fulfil this function adequately.

Batch variations in the speed of both paper and film may make comparative exposure times unreliable as absolute *values. Once determined, however, the relationship will be constant.*

INSERTING CAPTIONS AND MAKING CAPTION FRAMES

As will be apparent from previous statements, certain frames in a planned strip will require captions. They are added to impart additional information or to clarify a difficult picture or visual statement.

The number of captions required may vary considerably, but in this respect each frame should be considered on its own merits, and, as a general rule, the fewer titles the better. If numerous they can prove distracting. At all events, titles must be clear and simple in order to be fully effective.

There are obviously many ways of labelling a frame, and the most suitable should be selected in accordance with the general layout. Three common methods are as follows:

(a) Numerals or letters in alphabetical order may be placed within the frame area, and in close apposition to the reference point. A key in the form of a table is then placed at one corner of the frame. This form of labelling takes longer for an audience to absorb, but the finished result is often neater.

(b) A one- or two-word title is sometimes necessary for the introduction of a picture. It is both wasteful and unnecessary to make a separate frame of so short a caption, and this type can unobtrusively appear above or beneath the actual picture.

(c) The suggestion just made is elastic, however, and where two or three one-word labels are necessary these can be appended in a minute ruled box to their reference point: no more than four should ever appear in a single frame.

(d) Linear diagrammatic labelling is more straightforward, but often a similar technique can be applied to continuous tone pictures. The format of the filmstrip frame is such that a square picture might fill, say, two-thirds of the frame, and the remaining third could be filled by a list of titles. These should be so disposed to allow of indicator lines being drawn to the various reference points.

In addition to the above, whole frames may be devoted to simple explanatory text—this is a device which has long been used in the motion picture. These text-frames add considerably to the length of the strip if used too often; they should, therefore, be confined to logical sub-divisions of a strip and to terse injunctions (*e.g.*, Do's and Don'ts). Used sparingly, considerable emphasis may be imparted by this means. (See Figs. 14a and 14b.)

Reference was made above to the boxing of small titles to be included in the picture area. These may be inscribed boldly with a typewriter, and subsequently cut out and stuck in position. Typescript will reproduce well, though it is advisable to use a first carbon copy which has been faced on both sides with carbon paper; this will give a denser and more even impression than the original. When the key-print method is employed it may be possible to print these titles on to the surface of the bromide paper. For this purpose the Gestetner Diapositive Stencil may be employed; this is essentially the same as other typewriting stencils, but has been steeped in a yellow dye and therefore permits the passage of white light only through the characters which have been cut.

Whole title frames are best dealt with:

(a) by hand *(see section on lettering)*,

(b) by the use of a commercial stencil set such as the "UNO".

(c) by a cine titling outfit, of which there are many varieties.

Whichever method is used, remember that background tone affects the appearance of lettering considerably, and white characters on a black or grey ground is probably the least dazzling for the audience. In this respect white inks are not very satisfactory, for many are absorbed by the surface of black card, and the greyed result does not reproduce well. This difficulty may be overcome by preparing an original title frame with black ink on a white or grey card; photographing it, and subsequently preparing an intermediate transparency which is used as the negative for the final print. A quick alternative is to prepare a reflex print, which will be in the form of a negative with the characters reversed; care should be taken, however, to see that the white lettering is not veiled—this is then photographed on 35 mm. film, and subsequent printing is done through the base of the film to produce a corrected image.

A word about charts and graphs is also necessary. In order to fit in with the general conception of a filmstrip, these should, wherever possible, be represented pictorially. The construction and evolution of signs and symbols is not within our province here, but good examples are afforded by "Isotype" charts and posters. Apart from the fact that an average audience has not time to take in lists of figures momentarily appearing on the screen, it is only the agile-minded who can read a lengthy title and at the same time listen to a spoken commentary.

Whether graph, symbol, or the written word be employed, always make certain that it appears large enough when projected. The characters of a normal typewriter are about $\frac{1}{12}$ in. in height, and are designed to be read at a distance of about ten inches. By extension, therefore, they must be two inches in height on the screen to be read with equal ease at a distance of twenty feet—this example may serve as a guide for the solution of other lettering problems.*

Ilford Fine Grain Safety Positive film has been found to be most suitable for the production of title frames. Needless to say, any normal copying set-up may be used for straightforward production and special effects in lighting and texture may be achieved by the many methods used in the film industry.

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* *A formula relating to this matter is to be found on p. 35 of "Photography in Engineering" by Tupholme.*

" When preparing typescript for projection, it is not only the background but also the boldness of the type which determines legibility."

Fig. 14a
(*and*)
The effect of background and type face on legibility

" When preparing typescript for projection, it is not only the background but also the boldness of the type which determines legibility."

Fig. 14b

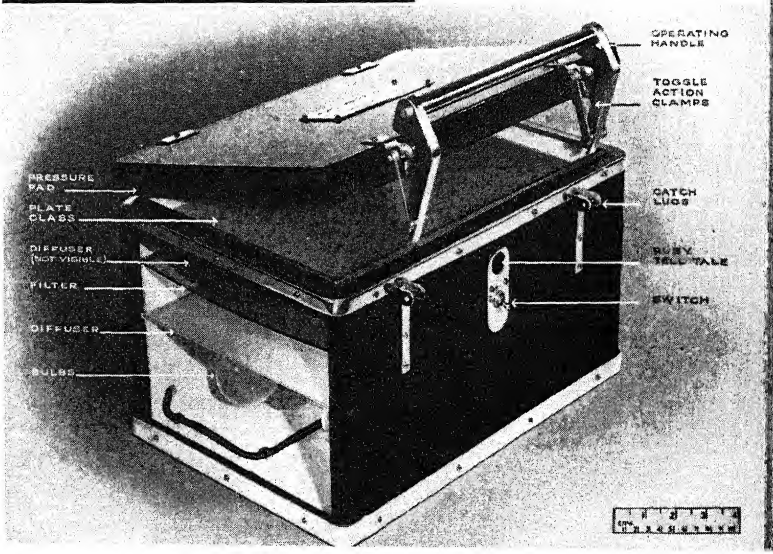


Fig. 15

TITLING AND LETTERING

In connection with the preceding note on making captions and labelling, a little guidance may be offered regarding the draughtsmanship involved.

The necessary skill can be acquired with a moderate amount of practice, particularly if simple forms are used to start with. Choose an alphabet which is easy to draw; if it is easy to draw, it is usually easy to read and, after all, that is the purpose of the caption.

MATERIALS

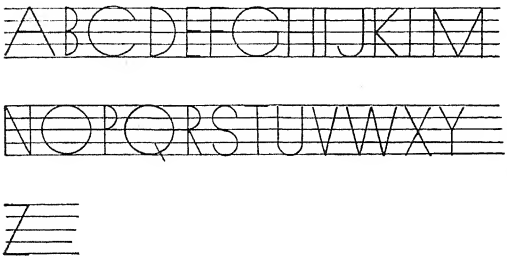
The simplest letter form is what is commonly called the "block letter", *i.e.*, all strokes are of the same thickness. This can be quite easily reproduced with special lettering pens made for the purpose. These nibs have a circular-shaped "flat" at the writing end so that a stroke of even thickness is achieved irrespective of the direction in which the nib is used. They are known as Script Pens and are available from stationers and dealers in artist materials, in sets of nine different sizes.

Another type of lettering pen is designed for "round hand" writing, having a spade-shaped writing point which gives thick vertical strokes and thin horizontal strokes. They are called Round Hand Pens and are also available in about twelve different sizes, complete with ink reservoirs which fit on the underside of the nib. In capable hands, these pens can be made to reproduce a wide variety of letter forms and lend themselves to the development and expression of individual style. An illustration of the use of these pens is given in the page of lettering examples.

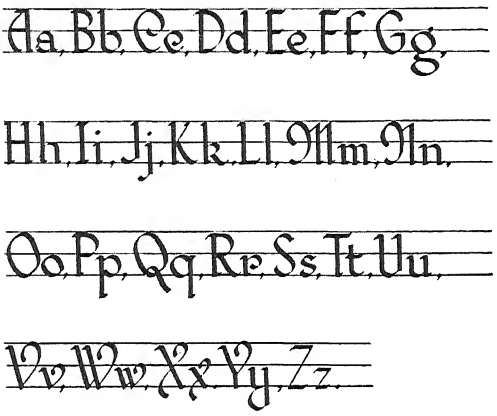
Alphabets can, of course, be drawn entirely with a ruler and compass, and although such titling takes longer, some workers may prefer this technique to freehand lettering. The result is always legible and exceptionally neat, but only capitals may be formed in this way, many of the small letters being too elaborate. Two such alphabets are illustrated.

The brush offers the greatest scope for all forms of lettering, but requires much more skill to use ably and a great deal of practice.

Lettering should be drawn in Indian ink, which gives an intense

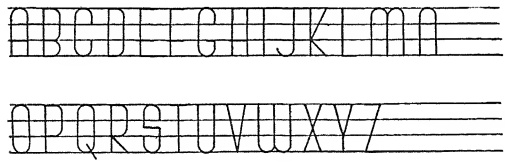


An alphabet built entirely of compass curves and ruled lines. Divide the height of the letters into four equal parts and use the compass point on these guide lines for describing all the curves.

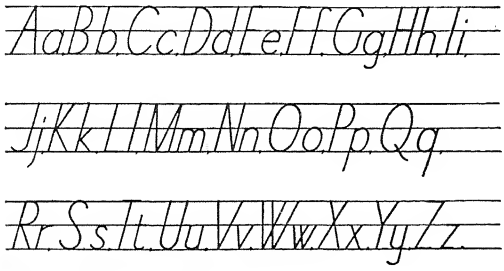


This alphabet is easily mastered and should be drawn with a pencil sharpened to a chisel point or with special round hand lettering pens. The flat surface of the pen or pencil should be held at about 45 degrees to the guide lines thus ensuring an even thickness to all down strokes.

A free-hand alphabet which may be varied to give full scope to individual expression of style.



Another alphabet whose curves are drawn with a compass, but in this case the height of the letter is divided into three equal parts.



A free-hand italic alphabet. It is important that the slope remains constant throughout and guide lines should be ruled at regular intervals at an angle of about 75 degrees or 80 degrees, using a template placed on the base line.

black suitable for copying; it also dries quickly and is waterproof. Pencil may also be used, the point being sharpened in the usual fashion or spade-shaped if round hand lettering is desired. However, pencil does not photograph as well and is liable to smudge with rough handling.

LETTER FORMS

Alphabets may be divided into three main classes:

(1) Block letters, technically known as sans-serif, in which a constant thickness of stroke is maintained. There are no serifs or projections at the beginning and end of strokes and the following is a typical example:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 1 2 3 4 5 6 7 8 9 0

(2) Serif letters, which preponderate in our reading matter, and of which the following is an example:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 1 2 3 4 5 6 7 8 9 0

(3) Round hand or script letters which are formed with a nib. Examples of this are Copperplate, Old English and many other interpretations. Old English should not be used for captions; it is difficult to read because it is only seen on rare occasions and our eyes are unused to its shapes.

These three main classes may be subdivided again into two:

(1) Roman or upright letters, as the examples already given, and

(2) Italic or leaning letters, as exampled below:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 1 2 3 4 5 6 7 8 9 0

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

a b c d e f g h i j k l m n o p q r s t u v w x y z 1 2 3 4 5 6 7 8 9 0

To avoid incongruity, it is important that some attention be paid to the individual shapes of letters and to the variations of form which are symbolic of the different styles. By incongruity is meant the mixing of different styles in the same word or phrase. For example, it would be wrong to place a serif letter in a word of block letters; or an italic with roman, or worse still, a capital with small letters (unless an initial) even though they were all of the same size. This may seem elementary but it has been done. To cite an extreme case, we have all seen the wayside notice offering TEAS, with the S drawn the wrong way round. A short study of the alphabet examples given will help to avoid any possible error.

GENERAL HINTS

1. Always rule guide lines lightly in pencil. Keep the letters within these lines. They can be erased when the work is finished.

Small letters should be about half the height of capitals.

2. "Rough out" the lettering lightly before filling-in or inking is attempted. This ensures that the caption is spaced evenly in the area allotted to it.

3. When drawing upright letters, make sure that they are really upright.

4. Italic letters should slope at an angle of about 75 degrees. Draw guide lines at this angle at frequent intervals and so keep the slope constant.

5. Spacing of capitals is important; equal spacing is not always desirable, *e.g.*, "open" letters like A, F, J, L, T, W, Y, require less spacing than the more "solid" letters, M, B, S, N, etc. For example thus: F I L M S T R I P is preferable to this: FILMSTRIP.

6. Round capitals like C, G, O, should encroach very slightly over the guide lines to overcome the illusion of smallness.

7. Long captions are more legible in capitals and small letters than when written entirely in capitals.

8. A word or phrase may be emphasised by writing it in a style contrasting with the rest of the text. For example, an italic in roman, small capitals in italics, or simply a bold version of the main text style.

TEST FOCUS FRAME

Both from the point of view of testing actual projection conditions and to avoid undue "fussing" with focusing on the first frame of a filmstrip, it is advisable to have a whole frame at the outset devoted to setting-up and focusing. This may be in the form of a standard frame for all strips, and hence a suitable standard negative may be prepared on 35 mm. film for the purposes of contact printing.

The word "Focus" should appear to avoid ambiguity, and the place or department of origin of the strip can also be profitably inserted. As a further refinement, the preparation of two such standard negatives might well be considered: one would be disposed along the axis of the film, and the other across it. By using the appropriate one, an indication can be given as to the disposal of the following frames, *i.e.*, either horizontal or vertical.

A background consisting of an enlarged portion of a half-tone screen has been found useful in this connection, for it is thus possible to see at a glance that the dot pattern over the *whole* field is in sharp focus—this may well be impossible if an inferior lens is used for projection; hence it is a further check on the optical system in use.

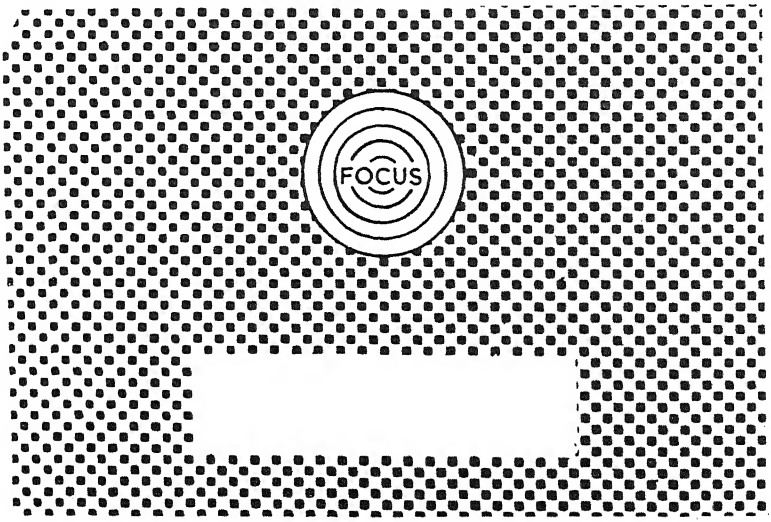


Fig. 16. A useful type of "Test Focus" frame

DETERMINING EXPOSURE TIME

Filmstrip making may include:

(a) exposures in the camera for the copying of key-prints, and

(b) exposure of the positive material in contact and projection printing.

We can deal with each of these in turn.

(a) COPYING KEY-PRINTS

Copying is usually carried out by artificial light and this can readily be controlled. In ordinary photography, exposures are calculated from the published speed index of the film or plate, taking into account the lighting conditions prevailing at the time. In copying, however, exposures are most readily found by means of a series of tests. This method enables exposures to be determined with a high degree of accuracy, an important consideration in copying where exposures are fairly critical. When the exposure has been determined for a given film the figure can be used repeatedly, provided the disposition of the camera, copy and lamps is unaltered.

As a starting-point for a series of tests the exposure found suitable in one particular instance for each of the recommended films is given below. When the exposure required for one film has been found by trial and error, that needed with another film can be calculated from these examples.

Exposure is simplified if a standardised arrangement of lights and copy is used each time. If it is necessary to change this, a photo-electric exposure meter, used as a light meter to compare the illumination provided by the old and new lighting, may eliminate the need for extensive testing with the new arrangement.

TYPICAL EXPOSURES

(i) *For the preparation of 35 mm. negatives*

Camera mounted so that 35 mm. frame covers 8 in. × 10 in.

Lighting: Four 150-watt lamps in reflectors at 2 ft. from the centre of the copy.

Subject: Black-and-white line drawing with typescript combined

Exposure: Ilford Fine Grain Safety Positive Film — 3 sec. at f/5·6
Subject: Glossy continuous-tone bromide print
Exposure: Ilford Pan F. 35 mm. miniature film — ½ sec. at f/5·6

(ii) *For the preparation of 35 mm. positives by reversal*
See pages 57 to 62—"Reversal of Ilford 35 mm. materials for making single copies of strips".

(b) CONTACT AND PROJECTION PRINTING

Exposures in ordinary contact or projection printing are normally determined by test strips in which adjacent areas of a strip of contact or bromide paper are given different exposures, the developed strip being examined to see which exposure gives the best result. A suitable initial series of exposures would be 5, 10, 20, 40 and 80 secs. Such a series will give an approximate indication of the required exposure and can, if necessary, be followed by a series of less widely separated exposures.

Exactly the same technique should be used for projection printing on to positive film or lantern slides. With the film the process can be simplified by using Normal grade bromide paper for the test strip, as explained on page 26—"The value of the 35 mm. paper print".

As a starting point for the use of test strips in contact printing, typical exposure times are given below. In projection printing conditions are too varied for typical exposures to have any real value.

TYPICAL EXPOSURES IN CONTACT PRINTING

For an average negative the approximate exposure times with a 15-watt gas-filled tungsten lamp at the distances stated are as follows:

	Lamp-negative distance	Exposure	
		Lamp in reflector	Lamp without reflector
	ft. in.	secs.	secs.
Ilford Fine Grain Safety Positive Film	4 0	7	14
Ilford Normal Bromide Paper B.2.1P	4 0	7	14
Ilford Contact Lantern Plate..	1 6	15	30
Ilford Special Lantern Plate; Soft, Normal, or Contrasty..	4 0	1	2

PART FOUR

MATERIALS

Detailed characteristics of Pan F. Film, Fine Grain Safety Positive Film, perforated normal bromide paper and various lantern plates: information relating to physical characteristics: special uses, colour sensitivity, exposure factors, resolving power, sensitometric curves, and packings available.

MATERIALS

In the foregoing pages a number of different methods of preparing a filmstrip have been described. For the preparation of the original negatives of both outdoor and indoor subjects a wide range of Ilford materials is available in all sizes. These materials will already be familiar from their use in ordinary photography and it is not proposed to describe them here. In the same way a wide range of Ilford papers is available for the preparation of key-prints and no further reference to them will be made here, except to say that in this, as in all copying work, a glossy surface is much to be preferred.

The positive film on which the filmstrip is printed, and the films on which the key-prints are photographed for the preparation of negatives, or positives by direct reversal, may, however, be less familiar to the user, and these materials are, therefore, described in detail in the pages which follow. Not all the materials listed are required for any one process, and in order to assist the user in selecting those needed for any particular operation an analysis of the materials according to use is given in Table 1.

An analysis of the materials according to characteristics is given in Table 2 and each material is described individually on pages 44 to 51.

TABLE 1. *ANALYSIS OF ILFORD MATERIALS ACCORDING TO USE*

1. FOR COPYING KEY-PRINTS

(*a*) *For the preparation of 35 mm. negatives*

(i) Black-and-white line drawings, typescript or printed text.
Ilford Fine Grain Safety Positive Film

(ii) Black-and-white half-tone or continuous-tone illustrations
Ilford Pan F. 35 mm. Miniature Film

(iii) Coloured half-tone or continuous-tone illustrations.
Ilford Pan F. 35 mm. Miniature Film

(*b*) *For the preparation of 35 mm. positives by direct reversal*

(i) Black-and-white line drawings, typescript or printed text.
Ilford Pan F. 35 mm. Miniature Film
Ilford Fine Grain Safety Positive Film

(ii) Black-and-white half-tone or continuous-tone illustrations.
Ilford Pan F. 35 mm. Miniature Film
Ilford Fine Grain Safety Positive Film

(iii) Coloured line drawings, typescript or printed text.
Ilford Pan F. 35 mm. Miniature Film

(iv) Coloured half-tone or continuous-tone illustrations.
Ilford Pan F. 35 mm. Miniature Film

For a filmstrip containing a mixture of line and half-tone or continuous-tone illustrations Pan F. is the best film, but if none of the key-prints includes coloured matter Fine Grain Safety Positive Film may be used as an alternative.

Note. Pan F. Film is primarily intended as a negative film and is coated on a base which is dyed grey for anti-halation purposes. This base colour, which cannot be removed, has the effect of reducing the light transmitted by the film to about 60 per cent. of the incident light. Fine Grain Safety Positive Film is coated on a clear base.

2. FOR PRINTING FILMSTRIPS FROM NEGATIVES

This may be done by contact or projection printing, and the material recommended in either case is:

Ilford Fine Grain Safety Positive Film.

3. FOR PRINTING PAPER GUIDE PRINTS

These may be required for estimating exposure or for reference purposes. The paper recommended is:

Ilford Bromide Paper, Normal, Glossy, Single Weight, 35 mm., perforated.

4. FOR PRINTING LANTERN SLIDES

(*a*) *Contact printing*
Ilford Contact Lantern Plate

(*b*) *Projection printing*
Ilford Special Lantern Plate
Available in three grades; Soft, Normal and Contrasty.

Special lantern plates may also be used for contact printing, but for this purpose they will require an exposure of only about one hundredth of that required with the Contact Lantern Plates normally recommended.

TABLE 2. ANALYSIS OF ILFORD SENSITIVE MATERIALS ACCORDING TO CHARACTERISTICS

Base	Name	Speed	Contrast	Grain	Spectral range of Sensitivity
Plate	Contact Lantern	Very slow	Extremely high	Extremely fine	U.V. and blue
Plate	Special Lantern, Contrasty	Slow	High	Very fine	U.V. and blue
Plate	Special Lantern, Normal	Slow	Medium	Very fine	U.V. and blue
Plate	Special Lantern, Soft	Slow	Medium to low	Fine	U.V. and blue
Paper	Bromide, Normal	Slow	Medium	Very fine	U.V. and blue
Film	Fine Grain Safety Positive	Slow	High	Very fine	U.V. and blue
Film	Pan F.	Medium	Medium to high	Very fine	U.V., blue, green and red

These characteristics apply to normal processing.
When Fine Grain Safety Positive, and Pan F. films are processed by reversal their behaviour differs somewhat from that indicated above. The grain of all of them is, if anything, still finer.

ILFORD PAN F. 35 mm. MINIATURE FILM

Nature of material
A very fine grain panchromatic emulsion of medium speed and medium-to-high contrast, on grey-dyed 5/1,000-in. safety base.
Uses
(1) For the preparation of negatives from key-prints comprising black-and-white or coloured half-tone or continuous-tone illustrations.
(2) For the preparation of positives by direct reversal from key-prints of all types.
Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time". Weston speed: 16, daylight; 10, artificial light.
Colour sensitivity
Panchromatic (sensitive to ultra-violet and to the visible spectrum).

Filter factors

	Alpha 104	Beta 401	Gamma 402	Tri. Blue 304	Tri. Green 404	Tri. Red 204
Daylight	1½	2	4	5½	6	10
Half-watt	1¼	1½	3	14	6	3½

Safelight recommended
None; the material should be handled in total darkness. But see page 55—"Safelights".
Development recommended
Use (1)

	60°F.	65°F.	68°F.	75°F.
ID-2, dish strength ..	6 mins.	4½ mins.	4¾ min.	2½ mins.

Use (2)
See pages 57 to 62—"Reversal of Ilford 35 mm. materials for making single copies of strips".

Sensitometric curves

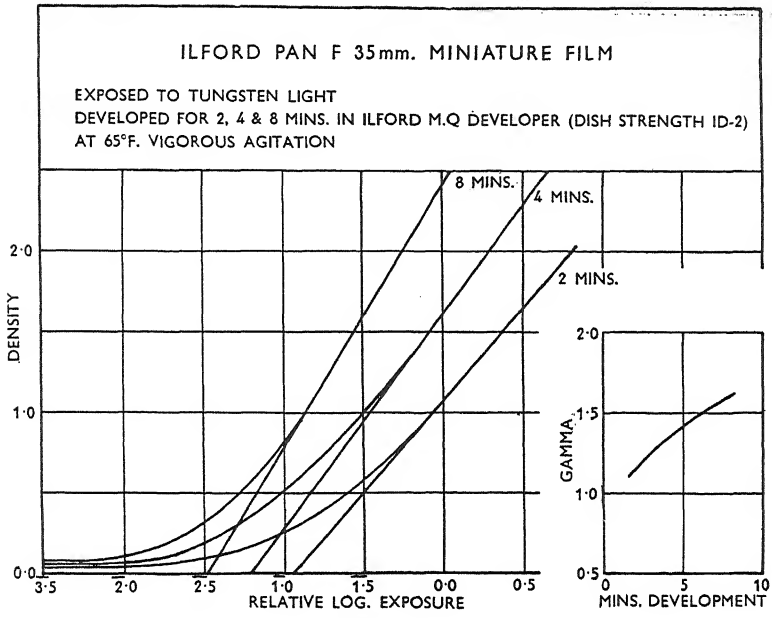


Fig. 17

Packings available

Cassettes, 36 exposures

Darkroom loading refills, 36 exposures
As single cartons or in boxes of six cartons.
Lengths of: 5 metres
10 metres
15 metres
25 metres
30 metres

ILFORD FINE GRAIN SAFETY POSITIVE FILM

Nature of material
A relatively slow, very fine grain, high-contrast, non-colour-sensitive emulsion, on clear 5/1,000-in. safety base.

Uses
(1) For the preparation of filmstrips from negatives by contact or projection printing.
(2) For the preparation of negatives from key-prints comprising black-and-white line drawings, typescript or printed text.
(3) For the preparation of positives by direct reversal from key-prints comprising black-and-white line drawings, typescript, printed text, half-tone or continuous-tone illustrations.

Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38 —"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and to blue).

Safelight recommended
Ilford "F" Safelight, No. 904 (dark brown). See page 55 "Safelights".

Development recommended
Uses (1) and (2)

	60°F.	65°F.	68°F.	75°F.
ID-2, dish strength ..	5¼ mins.	4 mins.	3½ mins.	2¼ mins.

Use (3)
See pages 57 to 62—"Reversal of Ilford 35 mm. materials for making single copies of strips".

Sensitometric curves

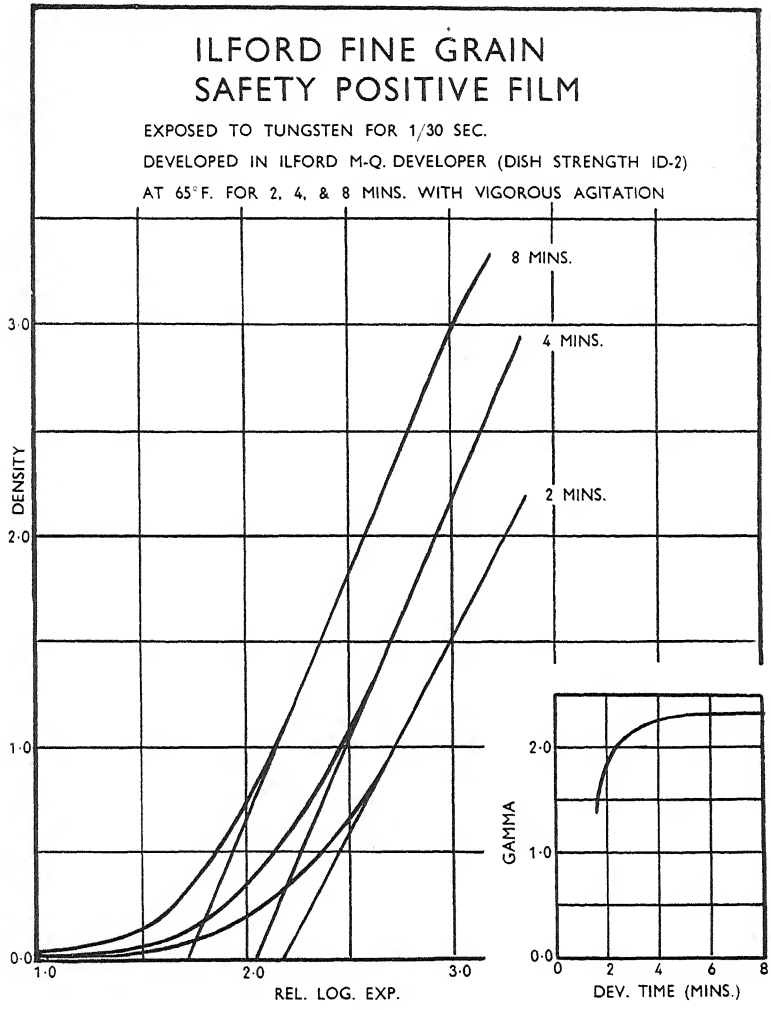


Fig. 18

Packings available

Lengths of 102 ft.
400 ft.
1000 ft.

When ordering, specify 35 mm. width, as the film is also made in 16 mm. width.

ILFORD 35 mm. BROMIDE PAPER

Nature of material
A relatively slow, non-colour-sensitive emulsion on perforated, glossy, single-weight paper, in Normal contrast grade only.

Uses
For making paper guide prints from negatives to assist in estimating the exposure time required when printing with Fine Grain Safety Positive Film, which is similar in speed and contrast.

Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and to blue).

Safelight recommended
Ilford "S" Safelight, No. 902 (light brown). See page 55—"Safelights".

Development recommended

	60°F.	65°F.	68°F.	75°F.
ID-2, dish strength ..	$2\frac{3}{4}$ mins.	2 mins.	$1\frac{3}{4}$ mins.	$1\frac{1}{4}$ mins.

ID-20 and ID-36 at bromide paper strength may also be used as alternatives, and development time will be the same.

Sensitometric curves
For characteristic curves of this paper compared with Fine Grain Safety Positive Film, see Fig. 13, page 27.

Packings available
Lengths of 100 ft.

ILFORD CONTACT LANTERN PLATE

Nature of material
A very slow, extremely high contrast, extremely fine grain, non-colour-sensitive emulsion.

Uses
For making lantern slides by contact, from all types of negatives.

Exposure required
For recommendations of the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and blue).

Safelight recommended
Ilford V.S. Safelight No. 901 (yellow). See page 55—"Safelights"

Development recommended

	60°F.	65°F.	68°F.	75°F.
ID-36, see page 57	1¼ mins.	1 min.	¾ min.	½ min.

Packings available
Sizes: 3¼ in. × 3¼ in. (for standard projectors); 49·3 mm. × 49·3 mm. (for miniature projectors). In boxes of 12, backed or unbacked, to order.

ILFORD SPECIAL LANTERN PLATE, SOFT

Nature of material
A relatively slow, medium-to-low contrast, fine grain, non-colour-sensitive emulsion.

Uses
For making lantern slides by projection or by contact from hard contrast negatives.

Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and blue).

Safelight recommended
Ilford "F" Safelight, No. 904 (dark brown). See page 55—"Safelights".

Development recommended

	60°F.	65°F.	68°F.	75°F.
ID-36, see page 57	$2\frac{3}{4}$ mins.	2 mins.	$1\frac{1}{2}$ mins.	$1\frac{1}{4}$ mins.

Packings available
Sizes: $3\frac{1}{4}$ in. × $3\frac{1}{4}$ in. (for standard projectors); 49·3 mm. × 49·3 mm. (for miniature projectors). In boxes of 12, backed or unbacked, to order.

ILFORD SPECIAL LANTERN PLATE, NORMAL

Nature of material
A relatively slow, medium contrast, very fine grain, non-colour-sensitive emulsion.

Uses
For making lantern slides by projection or by contact from normal contrast negatives.

Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and blue).

Safelight recommended
Ilford "F" Safelight, No. 904 (dark brown). See page 55—"Safelights".

Development recommended

	60°F.	65°F.	68°F.	75°F.
ID-36, see page 57	2¾ mins.	2 mins.	1½ mins.	1¼ mins.

Packings available
Sizes: 3¼ in. × 3¼ in. (for standard projectors); 49·3 mm. × 49·3 mm. (for miniature projectors). In boxes of 12, backed or unbacked, to order.

ILFORD SPECIAL LANTERN PLATE, CONTRASTY

Nature of material
A relatively slow, high contrast, very fine grain, non-colour-sensitive emulsion.

Uses
For making lantern slides by projection or by contact from soft contrast negatives, and for all line diagrams.

Exposure required
For recommendations for the exposure required in various circumstances, see pages 37 and 38—"Determining exposure time".

Colour sensitivity
Non-colour-sensitive (sensitive to ultra-violet and blue).

Safelight recommended
Ilford "F" Safelight, No. 904 (dark brown). See page 55—"Safelights".

Development recommended

	60°F.	65°F.	68°F.	75°F.
ID-36, see page 57	4 mins.	3 mins.	2½ mins.	1¾ mins.

Packings available
Sizes: 3¼ in. × 3¼ in. (for standard projectors); 49·3 mm. × 49·3 mm. (for miniature projectors). In boxes of 12, backed or unbacked, to order.

PART FIVE

PROCESSING

Safelights:
Routine processing and formulary:
Reversal processing

SAFELIGHTS

The safelight screen recommended for use with each sensitive material has been given already. These screens consist of glasses coated with coloured gelatin passing light of the spectral quality to give maximum safety with the particular sensitive material with which they are intended to be used. Safelight screens may be obtained bound up with a diffusing screen, or, alternatively, with clear glass.

The choice of light source for illuminating the safelight screen and the ventilation of the darkroom lamp are both important. The light should be bright enough to give ease of working, but not so bright as to render the light unsafe, nor so hot as to damage the gelatin filter.

For darkroom lamps employing direct lighting a safelight screen incorporating a diffuser should be used with a 15-watt metal-filament electric lamp. A candle, small oil lamp, or incandescent gas lamp of similar brightness may be used as alternatives.

For darkrooms employing indirect lighting incorporating a diffusing system a clear safelight screen may be used, with a metal-filament electric lamp not exceeding 40-watt output, or other source of similar power.

With panchromatic materials the word "none" appears against the words "Safelight recommended", but the Ilford G.B. Safelight No. 908 (green-blue) may be used for observing the time during development, provided the sensitised material is shielded from the direct illumination of the safelight.

DEVELOPMENT

The development recommended with each material is given in the information on pages 44 to 52. With certain materials the recommended development varies with the use of the material. Care must

be taken to select the development appropriate to the work in hand. All the developers recommended are available as packed chemicals, as follows:

Ilford ID-2 M.Q. Developer for Plates and Films.

Ilford ID-11 Fine Grain Developer for Roll Films, Miniature Films and Plates.

Ilford ID-20 M.Q. Developer for Bromide, Plastika and Multigrade Paper.

Ilford ID-36 M.Q. Developer for Contact Paper and Lantern Plates.

Ilford ID-48 Extra Fine Grain Developer for Roll Films, Miniature Films and Plates.

For those wishing to make up their own developers, the formulæ of ID-2, ID-11, ID-20 and ID-36 are given below:

ILFORD ID-2 M.Q. DEVELOPER

Stock Solution

Metol	20 gr.	or	1 g.
Sodium sulphite (cryst.) ..	3 oz.		75 g.
Hydroquinone	80 gr.		4 g.
Sodium carbonate (cryst.) ..	2 oz.		50 g.
Potassium bromide	20 gr.		1 g.
Water, up to	20 oz.		500 c.c.

For dish development of plates and films and for the development of bromide paper strips, dilute 1 part with 2 parts of water.
For tank development of plates and films, dilute 1 part with 5 parts of water.

ILFORD ID-11 M.Q. BORAX DEVELOPER

Metol	20 gr.	or	1 g.
Sodium sulphite (cryst.) ..	4 oz.		100 g.
Hydroquinone	50 gr.		2·5 g.
Borax	20 gr.		1 g.
Water, up to	20 oz.		500 c.c.

This developer is used at full strength.

ILFORD ID-20 M.Q. DEVELOPER

Metol	15 gr.	or	0·75 g.
Sodium sulphite (cryst.) ..	1 oz.		25 g.
Hydroquinone..	60 gr.		3 g.
Sodium carbonate (cryst.) ..	1½ oz.		40 g.
Potassium bromide	20 gr.		1 g.
Water, up to	20 oz.		500 c.c.

For bromide paper, dilute 1 part with 1 part of water.

Note. The stock solution made up from the packed developer has twice the strength of the above stock solution and requires greater dilution. See instructions on packet.

ILFORD ID-36 M.Q. DEVELOPER

Metol	56 gr.	or	3 g.
Sodium sulphite (cryst.) ..	4 oz.		100 g.
Hydroquinone..	½ oz.		12·5 g.
Sodium carbonate (cryst.) ..	7½ oz.		187·5 g.
Potassium bromide	16 gr.		0·75 g.
Water, up to	80 oz.		2000 c.c.

For lantern plates use at this strength.

Note. The stock solution made up from the packed developer has twice the strength of the above stock solution and requires greater dilution. See instructions on packet.

REVERSAL OF ILFORD 35 m.m. MATERIALS FOR MAKING SINGLE COPIES OF STRIPS

1. The following instructions have been compiled to enable a single copy of a series of matched bromide prints or line drawings to be made into a film strip by means of reversing the negative image obtained from camera exposure. Two films are available.

Ilford Pan F. Film. Suitable for continuous tone and line drawings. This is the best of the two films for making continuous-tone pictures. The technique described overleaf will also give satisfactory results for line drawings. It has a permanently grey-dyed base.

Ilford Fine Grain Safety Positive Film. This film will give results comparable with those obtained with Pan F. film but it requires considerably longer exposures. It has a clear white base.

DETAIL OF REVERSAL PROCESS

2. Darkroom illumination

Pan F. is a panchromatic film of moderate speed. It should be handled as far as possible in darkness. For showing the time during development a lamp screened by an Ilford G.B. Safelight (green-blue) No. 908 may be used to illuminate the face of a clock. Fine Grain Safety Positive Film is not sensitive to green and red. It may, therefore, be handled by the fairly bright light of a lamp screened by an Ilford "S" Safelight (light brown) No. 902.

3. Solutions required

Note that the reversal developer to be used for Pan F. is different from that required for Fine Grain Safety Positive film.

REVERSAL DEVELOPER FOR PAN F. FILM

Metol	56 gr.		3 g.
Sodium sulphite (cryst.) ..	4 oz.		100 g.
Hydroquinone..	½ oz.		12·5 g.
Sodium carbonate (cryst.) ..	7½ oz.	or	187·5 g.
Potassium bromide	16 gr.		0·75 g.
Sodium thiosulphate (cryst.) (Hypo)	280 gr.		16 g.
Water, up to	80 oz.		2000 c.c.

This solution can readily be made from Ilford M.Q. Developer ID-36 (available in packed form) by adding hypo, as follows:

ID-36, Contact paper strength	80 oz.	or	2000 c.c.
20 per cent. plain hypo solution	3¼ oz.		80 c.c.

e.g., 4 oz (or 100 g.) hypo in water to make 20 oz. (or 500 c.c.) solution.

REVERSAL DEVELOPER FOR FINE GRAIN SAFETY POSITIVE FILM

Metol	56 gr.		3 g.
Sodium sulphite (cryst.) ..	4 oz.		100 g.
Hydroquinone..	½ oz.		12·5 g.
Sodium carbonate (cryst.) ..	7½ oz.	or	187·5 g.
Potassium bromide	16 gr.		0·75 g.
Sodium thiosulphate (cryst.) (Hypo)	35 gr.		2 g.
Water, up to	80 oz.		2000 c.c.

This solution can readily be made from Ilford M.Q. Developer ID-36 (available in packed form) by adding hypo, as follows:

ID-36, Contact paper strength	80 oz.	or	2000 c.c.
20 per cent. plain hypo solution	190 m.		10 c.c.

e.g., 4 oz (or 100 g.) hypo in water to make 20 oz. (or 500 c.c.) solution.

BLEACHING SOLUTION

Solution A

Potassium permanganate ..	35 gr.	or	2 g.
Water, up to	20 oz.		500 c.c.

Solution B

Sulphuric acid (conc.) ..	192 m.	or	10 c.c.
Water, up to	20 oz.		500 c.c.

These stock solutions will keep for a very long time. For use mix equal volumes of A and B.

Mix up a fresh mixture for each batch of films.

CLEARING SOLUTION

Sodium or potassium metabisulphite	1 oz.	or	25 g.
Water, up to	40 oz.		1000 c.c.

ACID HARDENING-FIXER, IF-15

First make two solutions as follows:

Solution A.

Water at about 125°F. (52°C.)	20 oz.	or	500 c.c.
Hypo	13 oz.		320 g.
Sodium sulphite (cryst.) ..	2½ oz.		60 g.

Solution B

Water at about 125°F. (52°C.)	6 oz.	or	150 c.c.
Boric acid	174 gr.		10 g.
Glacial acetic acid	345 m.		18 c.c.
Potassium alum (cryst.) ..	1 oz.		25 g.

When the chemicals are dissolved, slowly pour Solution B into Solution A whilst stirring and make up to 40 oz. (1000 c.c.). Allow to cool before use.

4. First exposure. Camera setting and illumination to be employed

Illuminate each print or drawing evenly by the equivalent of six 150-watt tungsten filament lamps in reflectors at two feet from the centre of the copy, the line joining the centre of the lamps to the centre of the copy making an angle of approximately 40 degrees with the surface.

The exposures will be approximately as follows:

Pan F. for both continuous-tone and line drawings 24 sec. at f/11
Fine Grain Safety Positive,
for line drawings .. .. 24 sec. at f/5·6
for continuous-tone pictures .. .. 50 sec. at f/5·6

Note. The contrast of this film in reversal is rather higher than that of Pan F. The original bromide prints should, therefore, be made on a softer grade of paper.

Exact exposure for the particular set of conditions and batch of film must be found by trial and error. It is suggested that a series of trial exposures should be made at half, equal to, and double the recommended exposure. Over-exposure will, of course, lead to a final positive which is too light. It is important that the lighting conditions be standardised: either the lamps should be run at a constant voltage or the voltage across the lamps be read and allowance made in exposure. A table of corrections for varying voltage is given below:

Volts on Lamps relative to Normal	Exposure relative to Normal	Volts on Lamps relative to Normal	Exposure relative to Normal
90/100	152/100	102/100	93/100
92/100	139/100	104/100	85/100
94/100	128/100	106/100	79/100
96/100	118/100	108/100	74/100
98/100	108/100	110/100	68/100

5. First development

An ordinary spiral tank may be used for the first development. Place the tank in a water bath to maintain the temperature constant at 68°F. (20°C.), and it is better first to fill the tank with the necessary quantity of developer, and adjust the temperature of the developer to 68°F. (20°C.). The temperature of the water bath may be required to be slightly above or below 68°F. (20°C.) in order to maintain the temperature of the developer at its proper level according to the temperature of the room.

Working in total darkness, the loaded spiral is then gently lowered into the developer and lifted out again to get rid of air bells before the cover is placed on the tank. Agitate during development by

giving a 5-second anti-clockwise rotation to the spiral every 15 seconds.

The development times for the two films, using the appropriate developers specified in paragraph 3, are as follows:

Pan F.	11½ mins. at 68°F. (20°C.)
Fine Grain Safety Positive ..	6 mins. at 68°F. (20°C.)

Time and temperature of development are very critical, half a minute difference in development amounting to the equivalent of nearly one stop in exposure.

It is best before the end of development to remove the cover of the tank so that the spiral with the film may be removed quickly from the developer and plunged into water for washing *(see paragraph 6)*. The developer, which is to be used again later *(see paragraph 12)*, should be poured into a convenient vessel until it is needed. The tank itself must be washed and should then be filled with the mixed bleaching solution in readiness for the bleaching operation *(see paragraph 7)*.

6. First washing
Wash for 3 minutes in running water.

7. Bleaching
Treat the film for 5 minutes in the bleaching solution detailed in paragraph 3 at 65–70°F. (18–21°C.) with continuous strong agitation by lifting the spiral from the solution and returning it rapidly and repeatedly. This vigorous agitation is necessary to ensure complete bleaching. White light should be switched on after the film has been 30 seconds in the bleaching solution and all subsequent operations are to be done in the light.

8. Second washing
Wash for 2 minutes in running water.

9. Clearing
Soak the film for 2 minutes in the clearing solution detailed in paragraph 3.

10. Third washing
Wash for 2 minutes in running water.

11. Second exposure
Remove the film from the spiral and give it the equivalent of 30 seconds at 18 inches from a 100-watt tungsten filament lamp. Insufficient second exposure will be followed by a reduction in density when the film is given the final fixation. Two or four times the

indicated exposure time may be given but excessive over-exposure may lead to foggy highlights.

12. Second development
This and subsequent operations must be done in dishes or tanks. Develop for 6 mins. at 68°F. (20°C.) in the remains of the first developer. The presence of hypo in this developer helps in giving clear highlights. The time of development is not critical, development being continued until maximum density results with no appreciable loss in density when the film is fixed.

13. Fixation
Fix for 10 minutes in the acid hardening fixing bath detailed in paragraph 3.

The purpose of this operation is to remove any unexposed silver halide and to harden the emulsion layer.

14. Fourth washing
Wash thoroughly as for normal photographic processing. After washing, surplus moisture should be removed from the film either by gently squeegeeing with a clean, wrung-out chamois leather, or the film should be given a final rinse in water containing a wetting agent. It is important that no drops of water should be allowed to remain on the back of the film.

Materials other than those listed in the sections on "Materials" and "Processing" may be found suitable for filmstrip production, but in general they should be reserved for special purposes or particular techniques. It should be remembered that many such materials do not lend themselves to the reversal process which is described.

PART SIX

MINIATURE LANTERN SLIDES

Marriage of techniques with those of slide production: advantages: mounting and binding: "spotting": filing and storage: viewing and viewers

MINIATURE LANTERN SLIDES

By definition these slides are 2 in. square, and are possessed of a central aperture slightly smaller than the standard miniature frame which is 24 mm. × 36 mm.; the corners of the inner aperture are commonly rounded. The thickness of these slides has been standardised in BSS 777/1947 as not greater than 3.6 mm. There are to be found on the market several types of miniature slide: the oldest and most familiar is probably the all-glass slide, exactly similar, except in size, to the standard $3\frac{1}{4}$-in. square lantern slide—in this case the emulsion is coated upon one of the sheets of glass, and is protected by binding up with a cover glass.

Next there is the cardboard-mounted slide: colour films commercially processed are commonly split into individual frames, and each frame of film is mounted direct in a hinged cardboard mount which is then sealed; no protective glass is incorporated, though the emulsion surface of the film is sometimes varnished. The "Ilford Card Mount" is of this type. It might be thought that these cardboard mounts offer little protection to valuable transparencies, but against this it should be borne in mind that great economy is effected and by virtue of their thinness large numbers can be filed in comparatively small boxes. Slightly more care must be exercised when using this type of slide, but the actual thickness of the cardboard itself does protect the film if such a slide happens to be slid along a smooth surface.

Finally there are to be found several types of temporary metal mounts, into which individual 35 mm. frames may be inserted between slips of glass. (See Fig. 19).

Miniature lantern slides should always be thought of in parallel with filmstrip, for the first steps in production are identical and the remainder of the technique differs but little with the two media. If considered apart, artificial limitations are imposed both on the miniature slide and on the filmstrip. A strip may fulfil an individual need for some considerable time, at the end of which it may be desirable to revise it; but if it is necessary only to change the order of sequence, this may be done without reprinting by dividing up the individual frames and mounting them in the form of slides. Some

workers go so far as to produce two copies of each strip, dividing one up as mentioned, and in this way they collect both sets of strips and slides. The latter prove to be much more flexible when it is desired frequently to change illustrative material for teaching purposes.

MOUNTING AND BINDING

The all-glass type of slide already mentioned is directly comparable to the $3\frac{1}{4}$-in. slide, and the method of binding is exactly similar. Though most projectors are designed only to project a picture of miniature frame size, some will, in fact, project one nearly 2 in. square, and, therefore, if glass slides are used, the picture area which can be used will depend directly upon the projector aperture.

The Ilford lantern plates for this type of work are packed in boxes of one dozen, and are available in the following grades:

Special Lantern. A fast plate suitable for slide making by enlarging, contact or reduction. With normal development this plate will yield slides of brilliant black tone, but warm tones may be obtained by any of the usual methods. In three contrasts—Soft, Normal, and Contrasty.

Contact Lantern. A slow plate for making slides by contact. Processing may be carried out in weak artificial light. Normal development in ID-36 produces an intense blue-black image, but warm tones are easily obtained by variation of exposure and development.

ILFORD 35 mm. TRANSPARENCY HOLDERS

These metal holders are specially made for mounting and projecting 35 mm. film in 2-in. × 2-in. miniature projectors.

The film is sandwiched between two sheets of thin glass which afford complete protection against dust and handling. The pack is then inserted into the back of the holder and held in position by a slide-on cover plate.

"SPOTTING"

With the larger lantern slides it has been the usual practice in this country to attach two small white paper discs or "spots" to the two top corners of the slide, when held in the correct viewing position. On projection the slide is inverted so that these spots appear at the bottom two corners facing the projector bulb. This practice may also be applied to the miniature slide, but, in view of the restricted space on which to affix such discs, the *American method has much

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** The American Method has recently been adopted by the British Standards Institute.*

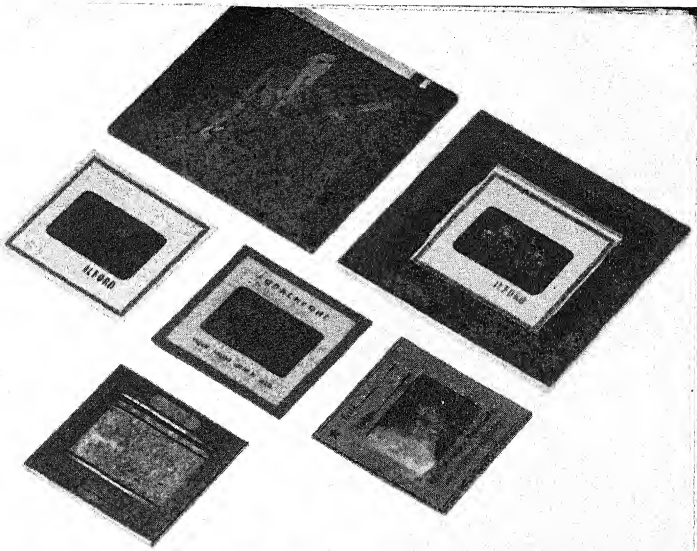


Fig. 19.
Various types of miniature slides and mountings

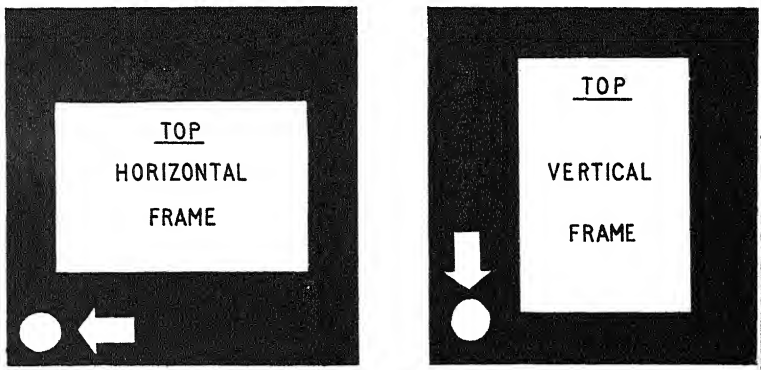
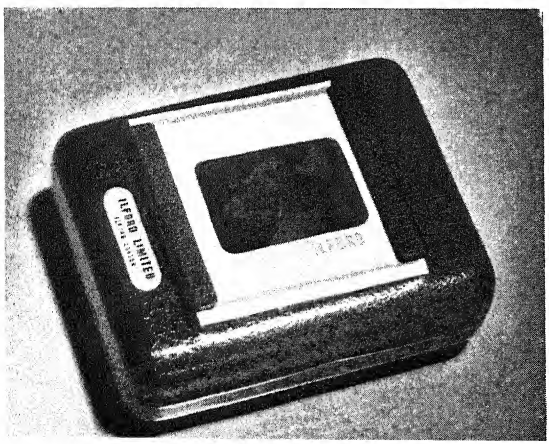
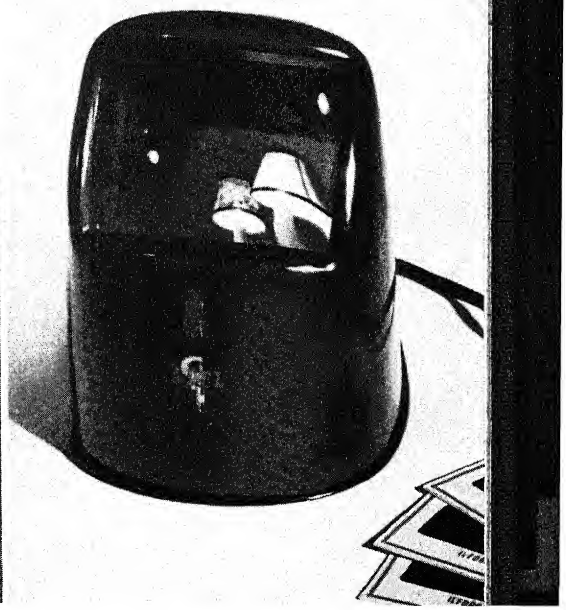


Fig. 20.
The new method of "spotting" all forms of lantern slides

Fig. 21a (right). Desk viewer for miniature transparencies. A mains/battery model

Fig. 21b (below). Ilford Transparency Viewer. This is self-contained and employs a battery





to recommend it. In this case a single mark, either black or white, is positioned in the left-hand bottom corner of the mount when correctly viewed in the hand. On projection it is customary for the operator to stand a little behind and to the right-hand side of the projector: in such an event the "spot" is covered by the thumb of the right hand as the slide is inserted into the carrier of the projector.

FILING AND STORAGE

Many types of storage boxes for 2-in. slides are at present available. The simplest of these is a thin metal box a little more than 2 in. deep, and divided into channels of width 2 in.—the advantage of this type of box is that a great deal of space is saved and slides of varying thickness may be stored with equal ease. Other boxes are built on much the same principle, but have the additional refinement of slots along the faces of the channels, so that the slides are evenly spaced and held apart. A single box may hold anything from 100 to 500 slides.

VIEWING

Miniature lantern slides may obviously be viewed by means of one of the types of projector described in Part Seven. It is quite common practice for filmstrip projectors to be equipped with a separate carrier for slides. It may not always be convenient, however, to arrange viewing by projection in this manner, in which case there are various types of alternative viewing apparatus on the market. The simplest type consists of an opal panel, illuminated from behind. The slide is placed on the opal panel. It is an advantage to use a magnifying lens to view the slide. This magnifying lens is sometimes provided as part of the viewer. (Figs. 21a and b).

The disadvantage of such a viewer is that it is only convenient for one person to use it at a time, but it is infinitely preferable to the practice of mounting many slides side by side on the face of some form of viewing lantern: in these circumstances it is difficult to do justice to any particular transparency in view of the distracting influence of the others which are illuminated at the same time. A visit to any exhibition in which this type of viewing is frequently employed will soon make this point clear.

Some workers advocate holding the finished slide up against the end of a cardboard postal tube, which is in turn directed at a diffusely illuminated white wall.

PART SEVEN

PROJECTORS and PROJECTION

Types and classes of projectors: the home-made projector: desirable features of a filmstrip projector: screens: back-projection screen and image sizes: lenses and "throw"

PROJECTORS

The modern miniature projector is designed on extremely efficient lines. Realising that it is a precision instrument the main feature, apart from efficiency and portability, is its relatively low cost. Its optical efficiency is reflected in the ability to project a brilliant picture in a lighted room, and from the point of view of portability it is almost as easy to transport it from town to town as from room to room; the desirability of these features will be apparent to all potential users.

For many projectors a complete range of lenses is available, and the instrument may be purchased with lens of focal length appropriate to the distance over which it is desired to throw the image—it is, therefore, as easy to cater for an audience of four or five in a small room as for an audience of three or four hundred in a hall, say, forty feet long: many such projectors have in fact been tested on a full-size cinema screen with surprisingly good results.

The low-voltage compact source illuminant has been extremely popular, though the added weight, which is necessary in the form of a transformer, is considered by many to be a disadvantage. Other instruments designed to run direct on A.C. or D.C. mains vary considerably in the type of lamp employed, but the usual range carries one of 100–500 watts.

There is indeed a large number of projectors from which to choose and the choice is usually determined by the specific use to which it is to be put, if not by cost. In view of the dual standards at present obtaining it is advisable to make sure that the projector is capable of carrying 2-in. square slides, and also both single- and double-frame filmstrips.

Other desirable features of a miniature projector are listed below, but it should be made quite clear that few on the present-day market fulfil all requirements:

1. It should be light, compact, and portable. On the whole low-voltage lamps approximate more closely to a point source of illumination and are therefore possibly more efficient; the added weight and bulk of the necessary transformer is, however, a disadvantage over the direct mains-operated model.

2. The optical system should include an efficient heat filter to ensure that a lamp of maximum wattage can be employed without risk of over-heating the film. This feature will also entail good ventilation.

3. At least part of the condenser system should be changeable in order that maximum illumination can be provided for both single- and double-frame apertures.

4. Provision should be made for the accommodation of both filmstrip and the 2-in. square lantern slide. This is usually achieved by interchangeable gates or carriers.

5. The turret on which the lens and carrier are mounted should be capable of rotation through 90 degrees. Pictures may then be vertically or horizontally disposed at will.

6. The filmstrip transporting mechanism should be equipped with moving pressure plates, which have a *positive action*. Double-frame transport is often achieved by turning the operating knob or lever twice, but the risk of scratching the film may be further reduced by a longer release of the pressure plates for this double-frame operation.

7. The filmstrip transporter should be readily loadable: certain of these employ a scroll mechanism to rewind the strip as it passes through the projector; experience seems to show, however, that this increases the danger of scratching.

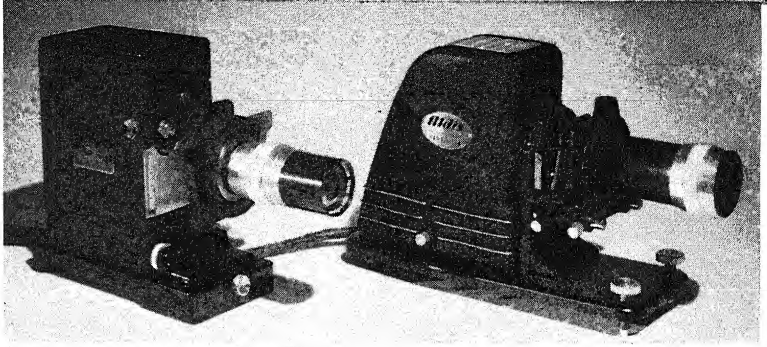
The slide carrier, on the other hand, should be able to accept slides of varying thickness, and to this end registration springs usually ensure a good grip.

8. Finally the lens barrel should be well blackened within, and should be of adequate diameter to permit the inclusion of circular flanges or baffles. Needless to say, definition should be critical over the entire double-frame field.

Despite the comparatively low cost of commercial filmstrip and slide projectors, some workers may wish to build and perfect their own projection apparatus. In this event, full constructional details may be obtained from the Ministry of Education Pamphlet, *Filmstrip Projector;* Ref. 75/11.

More detailed information concerning projectors and the adaptation of premises for projection is to be found in the Board of Education Educational Pamphlet No. 115, entitled *Optical Aids* (H.M.S.O., 1*s*. 6*d*.). This publication in turn gives a number of additional references.

Figs. 22, 23 and 24. Various filmstrip and slide projectors



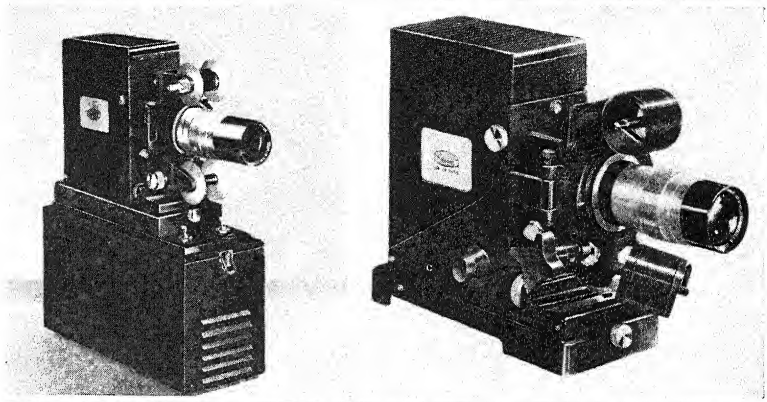


Fig. 23

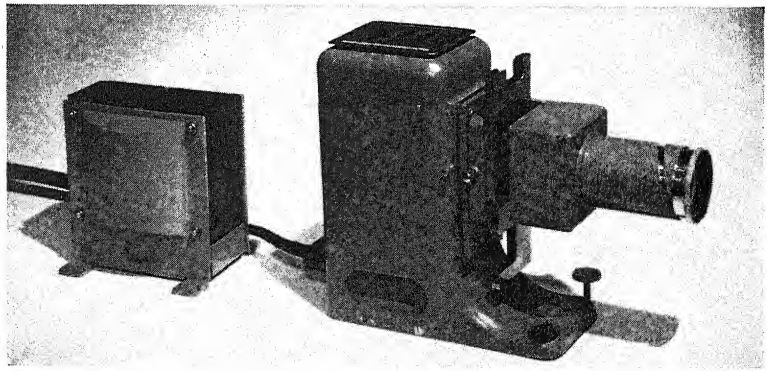


Fig. 24

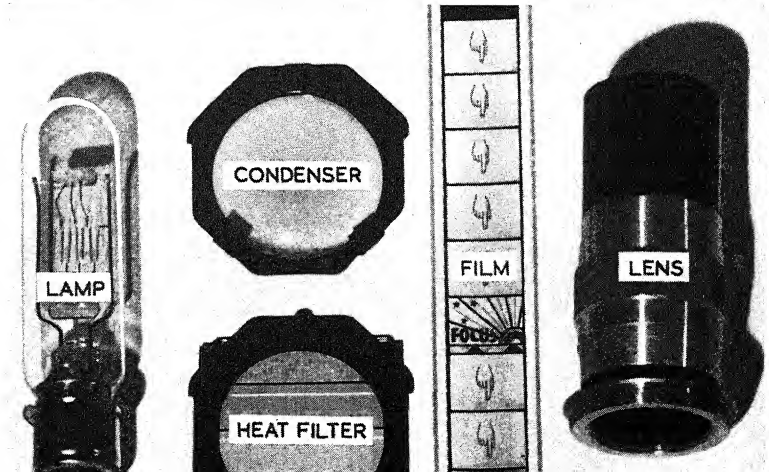


Fig. 25. The essential components of a projector miniature

PROJECTION

The actual use of a miniature projector and the manner of projection is also largely an individual one, but, given a high-efficiency projector, it is only fair to ensure that the screen is of equal excellence, for otherwise there is no point at which the projected image can be so easily marred.

Of screens there is an equally wide choice, but in general these can be resolved into three main types:

(a) The matt white screen, either painted direct on a wall or else in the form of a tightly stretched canvas. This is probably the one of choice for all general purposes, but it is the most difficult to keep clean.

(b) The silver screen—a screen painted with aluminium or similar paint.

(c) The beaded screen—this is a screen whose surface is covered with minute white or clear glass beads. It is capable of reflecting an image of great brilliance, though the angle at which it may be viewed is restricted.

Most of these screen surfaces are available in the form of portable or folding screens, but when projection facilities in any one room are of a permanent nature, a permanent screen applied directly to one of the walls cannot be bettered. The final choice will probably be determined by the space available, the shape of the room, and the size of the audience.

With set projection facilities there is little excuse for a bad result, but for the travelling projectionist the following table relating focal length of lens to image size may be found useful.

TABLES OF PICTURE SIZES

The following two tables give the size of the projected image at different screen distances, for lenses of 3 in., 4 in. and 6 in. focal length, when using either of the two recognised frame sizes.

18×24 mm. FRAME SIZE

Distance from Screen in feet	Size of Image on Screen											
	3-in. lens				4-in. lens				6-in. lens			
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
5	1	1	× 1	6	0	10	× 1	1	0	6	× 0	8
10	2	4	× 3	1	1	9	× 2	3	1	1	× 1	6
15	3	6	× 4	8	2	7	× 3	6	1	9	× 2	3
20	4	8	× 6	3	3	6	× 4	8	2	4	× 3	1
25	5	10	× 7	10	4	4	× 5	10	2	11	× 3	10
30	7	0	× 9	4	5	3	× 7	0	3	6	× 4	8
35	8	2	× 11	0	6	2	× 8	2	4	1	× 5	5
40	9	4	× 12	7	7	0	× 9	4	4	8	× 6	3
45	10	7	× 14	1	7	11	× 10	7	5	3	× 7	0
50	11	9	× 15	8	8	10	× 11	9	5	10	× 7	10

24×36 mm. FRAME SIZE

Distance from Screen in feet	Size of Image on Screen											
	3-in. lens				4-in. lens				6-in. lens			
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
5	1	6	× 2	3	1	1	× 1	8	0	8	× 1	1
10	3	1	× 4	7	2	3	× 3	5	1	6	× 2	3
15	4	8	× 7	0	3	6	× 5	2	2	3	× 3	5
20	6	3	× 9	4	4	8	× 7	0	3	1	× 4	7
25	7	10	× 11	8	5	10	× 8	9	3	10	× 5	9
30	9	4	× 14	1	7	0	× 10	6	4	8	× 7	0
35	11	0	× 16	5	8	2	× 12	4	5	5	× 8	2
40	12	7	× 18	9	9	4	× 14	1	6	3	× 9	4
45	14	1	× 21	2	10	7	× 15	10	7	0	× 10	6
50	15	8	× 23	6	11	9	× 17	8	7	10	× 11	8

Many teachers prefer to have the projector directly under their own control in order more exactly to regulate the tempo of their exposition. One or two remote-control devices are sparingly available,

but the problem is easily overcome in a confined space by the expedient of back projection. The accompanying diagrams are fairly self-explanatory, showing how a mirror and a translucent screen are employed. This arrangement of a suitably hooded screen allows of

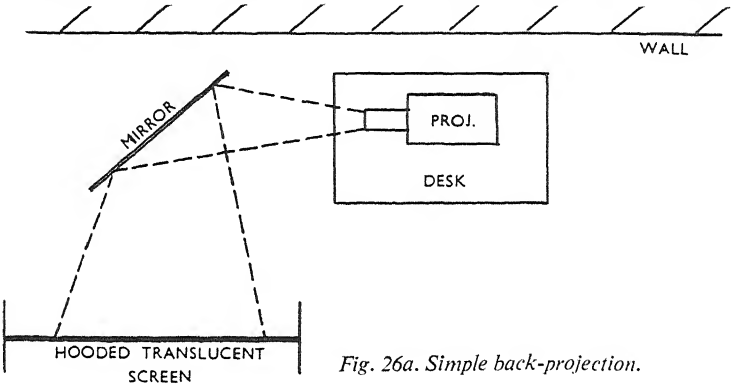


Fig. 26a. Simple back-projection.

brilliant projection in daylight. It should be remembered, however, that on account of the mirror, filmstrip or slide must be reversed in the projector.

Fig. 26b shows how oblique projection may be employed with the same ends in view. This, however, is only applicable to a restricted audience, for distortion of the picture will result if it is viewed from too far back.

The above is by no means intended to be an exhaustive comment on projection, but readers with specific problems will find more detailed information in the Stationery Office publication entitled *Optical Aids*.

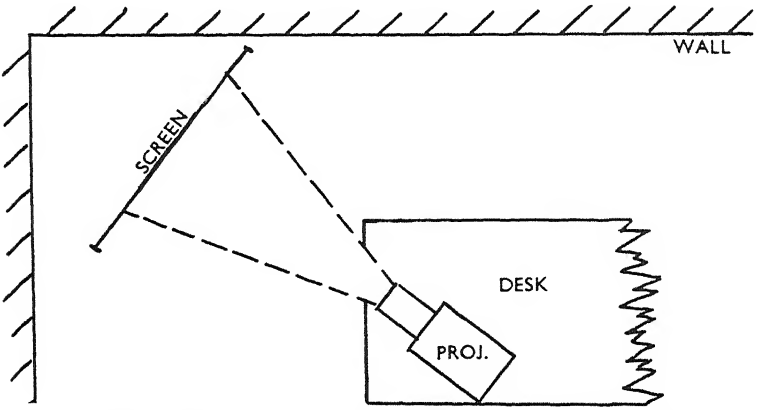


Fig. 26b. Arrangement whereby the projector is under the complete control of the teacher

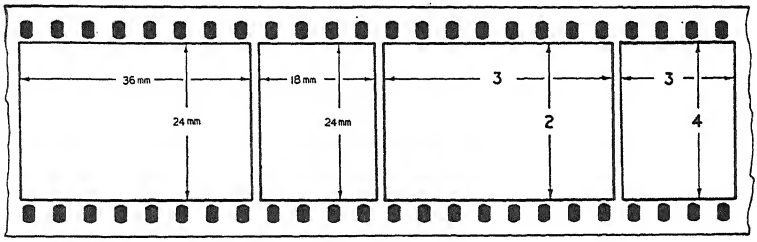
PART EIGHT

APPENDICES

A. Various suggested frame sizes for special purposes
B. Copyright material

APPENDIX A

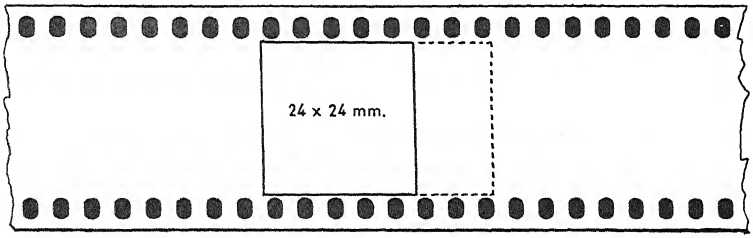
SUGGESTED FRAME SIZES FOR SPECIAL PURPOSES



From time to time individual users of filmstrip have found the two recognised frame sizes inconvenient for one reason or another. Others have felt that, though excellent in many ways, the whole medium of filmstrip could be improved by modification of the frame area.

For this reason a number of "odd" frame sizes have been advocated, and in case they are of use in special applications these are listed below with appropriate diagrams. Of course it will be realised that in many of these examples some modification of the projector aperture will be necessary for successful projection.

1. Certain miniature cameras on the present market are designed to produce a square picture on 35 mm. film. In this way the composition is made to fit into a square format and the necessity of rotating the camera from a horizontal to a vertical position is avoided.

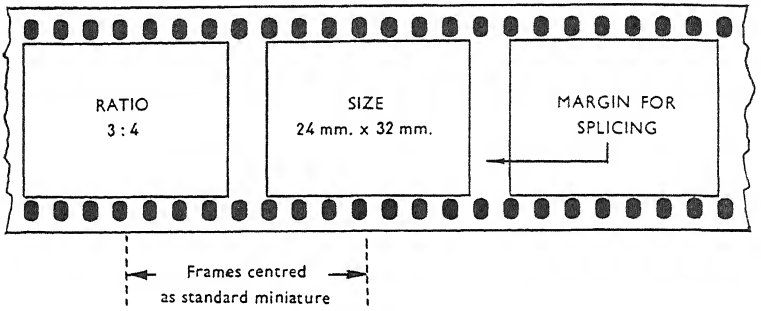


When printing this type of negative on the 35 mm. printing box, as described in previous pages, either a special mask can be fitted or the remainder of the space (shown dotted in above diagram)

may be used for frame numbering or titling by means of a second printing.

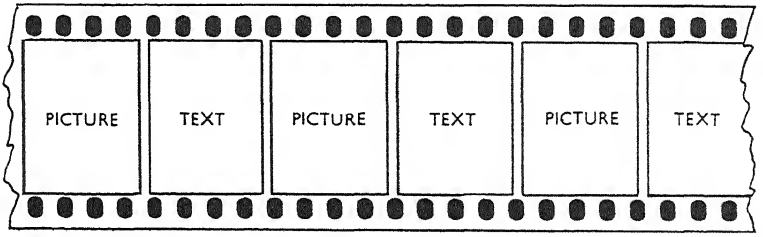
2. Many people have complained that the miniature frame size is wasteful and is of an inconvenient format. The sides are in the ratio of three to two, whereas the single or cine-frame size has sides of ratio four to three; this is often considered to be preferable.

As a result of this, a three-to-four frame with its longer side along the axis of the film has been suggested.



Further complications can be avoided by spacing the frames with their centres the same distance apart as the standard double frame. A convenient margin for splicing is thereby afforded.

3. Finally fully descriptive strips may be prepared by using the single-frame standard and printing text or notes and pictures alternately.



A strip prepared in this manner may be projected with the usual projector and the following combinations are obtainable:

(a) Double-frame projection—this shows both the picture and text on the screen at the same time.

(b) Single-frame projection, with single winding of operating knob—this gives a picture followed or preceded by its text.

(c) Single-frame projection, but with double winding of operating knob—this permits either pictures only or text only to be shown.

APPENDIX B. COPYRIGHT

The legal position with regard to the use of copyright material is as clear as it is simple. It is a breach of copyright to make a copy of anything without permission of the owner of the copyright. The British Film Institute recently sought legal advice on the use of copyright matter and the following advice was given:

"*Rights of reproduction*

The reproduction without the consent of the owners of the copyright of any protected work or any substantial part thereof in any material form, is an infringement of copyright. The only exceptions to this rule, which are material for the present purpose, are:

(a) If a teacher were to use an epidiascope to throw on the screen in front of his class an illustration from a copyright book there would be no infringement; but if he were to make a film copy or slide of the illustration for use in the same way he would be infringing the copyright.

(b) Photographs of sculpture or craftsmanship permanently situate in a public place or building do not involve an infringement of copyright.

Conclusion. If it is proposed to use copyright material, it is essential in the first place to get the consent of the owner of the copyright. It is important that any use of copyright material should be within the terms of the permission given."

Almost all books, periodicals, pictures, photographs, illustrations, diagrams, maps, tables, etc., are copyright, for it is reasonable that the person who has created original material should be protected from having it used by other people without his permission, and entirely unreasonable that one person should take and use, whether for financial gain or not, another person's property. The Copyright Act of 1911 and the Berne convention exist for the purpose of safeguarding from piracy every form of book, picture, periodical, map, and so forth.

It will be found in practice that authors, publishers and other owners of copyright are, as a rule, quite willing to grant permission for their copyright material to be used. It is only necessary to approach them—it is best to write—stating what it is desired to copy

and for what purpose; and the number of copies which will be made and how they will be distributed. If, for instance, it were desired to include an illustration from a book in a filmstrip, and for the filmstrip to be solely for use within an institution, the application for permission would state these facts. If, on the other hand, it were desired to sell the filmstrip, to give it away, or to put it on loan, the particulars should be given of the number of copies which it is intended to make and the class of people to whom the copies will be sold, given away or loaned.

When granting permission for the use of copyright material, three conditions are generally made by authors and publishers:

(a) That due acknowledgement is given as to the source from which the material is taken.

(b) That arrangements be agreed in advance as to the manner in which copyright material is used.

(c) That reasonable payment is made where the copyright material is to be put to commercial use and in certain other circumstances, *e.g.*, where the proposed use of the copyright material would be damaging in some way to the Publisher's and/or Author's interests.

It should not be overlooked that the author, artist, publisher or other owner of a copyright may have been at great labour and expense to produce the material it is desired to copy; that he is concerned to see that any copy or reproduction of his original work is not likely to give a bad impression of it, and further that it is not used in a manner which may lessen its value or injure the reputation of the parties concerned. As an example of the last, an author might not wish to have illustrations from a book addressed to a profession included in a filmstrip designed for popular consumption. It will, therefore, be readily appreciated that the protection of copyright is not necessarily or solely concerned with financial rights, but may also be, and often is, governed by other considerations.

To those who make photographic copies of copyright material due care is obviously necessary to ensure that action is not taken which will amount to infringement of copyright. If advice or guidance is required at any time, it can be obtained by approaching such bodies as the British Film Institute, the Publishers' Association or the Authors' Society, but no difficulty will be experienced as a general rule in making satisfactory arrangements for the making of copies of copyright material. It is always as well to allow plenty of time when applying for permission to copy, for the publisher may not own the copyright in which case he has to apply to the author, or artist, or perhaps to both to secure their consent.